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**Early Caregiving and Child Executive Function:
Examining Preschool-aged Children with Prior Maltreatment**

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A thesis submitted in fulfilment of the requirements for the degree of

Doctor of Philosophy

Faculty of Science, School of Psychology

University of Sydney

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Statement of Authentication

This thesis is submitted to the University of Sydney in fulfilment of the requirement for the Doctorate of Philosophy. The work presented in this thesis, is to the best part of my knowledge and belief, original except as acknowledged in the text. I hereby declare that ethical clearance was gained for this work and I have not submitted this material, either in full or in part for a degree at this or any other institution.

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A handwritten signature in black ink, appearing to read 'T. Fry' followed by a stylized flourish.

Abstract

Early maltreatment can negatively impact the development of executive function. This thesis, comprising a systematic review and three separate studies, examined the relationship between maltreatment, emotion-related parenting behaviours and executive function in a sample of maltreated and non-maltreated children. Children ($N = 107$; aged 4 and 5 years), along with their parent or caregiver, were recruited from three cohorts: foster care children with substantiated maltreatment; children that child protection services referred for early intervention for identified maltreatment risk; and typically developing children with no maltreatment. Executive function was assessed using three performance-based measures (Happy–Sad Stroop Task, Tapping Test and Dimensional Change Card Sort) and a caregiver rating scale (Behaviour Rating Inventory of Executive Function). Parenting was assessed by the self-report questionnaire Coping with Children’s Negative Emotions Scale, and parental depression was assessed by the Depression, Anxiety and Stress Scale. Children’s maltreatment types coded on family-level maltreatment reports and child protection services reports, were used to compute an index of maltreatment risk.

The thesis’ systematic review examined the relationship between parenting and executive function in 23 early childhood studies. Executive function was associated with four theoretically derived dimensions of parenting: scaffolding, stimulation, sensitivity/responsiveness versus hostility/rejection, and control. Child factors of ethnicity, temperament and physiological self-regulation (e.g., cortisol) were variables found to moderate the association between parenting and executive function. Findings also suggested that children’s stress-response systems (i.e., the hypothalamic-pituitary-adrenal axis) and language comprise two mechanisms through which parenting may influence change in executive function across early childhood.

Study 1 examined the association between caregiver rating scales and performance-based measures of executive function in the preschool-aged children ('preschoolers'). Consistent with previous research, associations between these forms of measurement were limited on the whole (only five of 15 (33%) correlations were statistically significant). This study provided novel evidence to suggest that environmental factors may account for this poor concordance, with results indicating that severity of child maltreatment partially moderated the association between caregiver rating scales and performance-based executive function measures. Specifically, measures were more closely associated in children exposed to low maltreatment than those exposed to high levels of maltreatment.

Study 2 examined associations between maltreatment, emotion related parenting behaviours, and preschoolers' executive function as indexed by performance-based measures. Maltreatment was found to uniquely predict executive function, independent of the covariates of parental depression and ethnicity. Further, parents' emotion-related socialising behaviours moderated the link between maltreatment: supportive parental reactions buffered harmful effects of maltreatment on executive function, and while unsupportive reactions amplified the risk.

Study 3 examined the common versus distinct environmental correlates (maltreatment, emotion-related socialising behaviours and family factors) of emotion regulation versus cognitive regulation (i.e., executive function). The findings from this study indicated that parent-ratings of children's emotion regulation and cognitive regulation were both associated with maltreatment, but that the relationship between maltreatment and child emotion regulation was moderated by parenting. The relationship between maltreatment and child cognitive regulation, however, was not. The results of this thesis highlight the need for comprehensive maltreatment prevention models. Findings support the value of early executive function screening, evidenced-based parenting programs and early education

programs as potential avenues for improving the cognitive outcomes in maltreated pre-schoolers. They also point to specific forms of caregiving that may serve as particularly beneficial targets within such programs.

Key words: executive function, maltreatment, early childhood, parenting practices, self-regulation

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List of Publications and Presentations

Journal publication (forms Chapter 2 of this thesis):

- Fay-Stammbach, T., Hawes, D. J. & Meredith, P. (2014). Parenting influences on executive function in early childhood: A review. *Child Development Perspectives*, 8(4), 258–264. doi:10.1111/cdep.12095

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- Fay, T. (2013). The neuro-cognitive impact of early life stress on preschool children. *Occupational Therapy Australia 25th National Conference*, July 24–26th, Adelaide.

List of Abbreviations

ADHD	Attention Deficit Hyperactive Disorder
BRIEF	Behaviour Rating Inventory of Executive Function
CC	Community Comparison
CCNES	Coping with Children's Negative Emotions Scale
DCCS	Dimensional Change Card Sort
ERSBs	Emotion-Related Socialisation Behaviours
MR	Maltreatment Risk
PPVT	Peabody Picture Vocabulary Test
VIF	Variance Inflation Factor
ANCOVA	Analysis of Covariance
DASS	Depression Anxiety Stress Scales

Chapter 1: Introduction

1.1 Overview

This thesis comprises three studies that together examine the impact of early adverse consequences of child maltreatment on executive function development in preschool-aged children ('preschoolers'). 'Executive function' is generally defined as a set of higher-order cognitive processes that govern goal-directed action and adaptive responses under conditions of novelty, distraction or conflicting task demands (Hughes, Graham & Grayson, 2005).

There is mounting evidence that early life stress or adverse childhood experiences, particularly those during sensitive periods of brain development, increase the likelihood of a multitude of negative outcomes over time (Pechtel & Pizzagalli, 2011; Yates, Obradovic & Egeland, 2010). One extreme and toxic form of early life stress is child maltreatment, which includes physical neglect, and physical, emotional and sexual abuse. Maltreated children have an increased risk of negative developmental outcomes such as cognitive delay, academic and school adjustment problems (for a review, see Cicchetti & Valentino, 2006). Although higher cognitive abilities of executive function or executive control are robust predictors of academic achievement, few studies have examined the association between maltreatment and executive function in preschoolers receiving child protection services (De Bellis, Woolley & Hooper, 2013; DePrince, Weinzierl & Combs, 2009).

Research gathered from separate domains of enquiry suggest that child maltreatment may be negatively associated with executive function through three pathways of influence; however, few studies involving preschoolers have considered these processes simultaneously in order to determine their independent or joint effects (Cicchetti, 2012). One pathway of influence suggested by researchers is that maltreatment disrupts stress-response systems (allostatic load) and affects emotion dysregulation, which further hinders optimal

development of executive function (Calkins & Marcovitch, 2010; Marshall & Kenney, 2009; Ursache, Blair & Raver, 2012). A second pathway of influence includes disruptions in the relational processes between the parent and the child, or the quality of parenting, specifically in respect to parental stimulation, scaffolding, sensitivity or discipline are associated with child executive function (Fay-Stammbach, Hawes & Meredith, 2014). Another ~~One~~ aspect of parenting with proposed links to children's self-regulatory capacities, is the way parents socialise their child's emotion regulation, particularly through their responses to their child's display of distress (Lunkenheimer, Shields & Cortina, 2007; Morris et al., 2011). A third pathway of influence is that children exposed to maltreatment are frequently exposed to co-occurring contextual risk factors, including low income, parental mental health problems, and disrupted family relationships, which have been associated with executive function (Rhoades, Greenberg, Lanza & Blair, 2011; White, Hindley & Jones, 2014). The present investigation integrates these three broad areas of research by using an ecological-transactional model of executive function development to examine the complex interplay among the processes of maltreatment, quality of parenting and contextual risk on child executive function (Bronfenbrenner & Morris, 1998; Cicchetti & Valentino 2006).

In this chapter, the background to the thesis is explored, and the research aims are introduced. Section 1.2 outlines the context for this study, the major types of child maltreatment and the scope of the problem. Section 1.3 provides a detailed account of the executive function construct and its significance and development, while section 1.4 describes the ecological-transactional perspective of human development that frames this study's multilevel analysis. Section 1.4 also summarises the literature that links the development of early executive function to key factors of a child's ecology in order of closest proximity to the child, beginning with caregiving factors (e.g., maltreatment and parenting styles), followed by family contextual factors (e.g., parental depression) and child

characteristics (e.g., age, language). Section 1.5 then provides a rationale for this study, and section 1.6 presents the research aims. The chapter concludes with an outline of the thesis structure.

1.2 Context for the Study: Child Maltreatment in Early Childhood

Child maltreatment is the leading preventable cause of major mental illness (Felitti et al., 1998). Maltreatment triggers harmful effects on child development that range from physical health problems (e.g., fractures) to social-emotional (e.g., externalising behaviour) and global cognitive deficits (Cicchetti & Toth, 1995; Felitti et al., 1998). Maltreatment involves a breakdown in the parent-child relationship that sets in motion cascading processes that may disrupt the attainment of stage-salient tasks of emotional, behavioural and cognitive development (Cicchetti, 2012; Diamond, 2013). Maltreated preschoolers display a range of problems including inattention, hyperactivity, impulsivity, aggression, non-compliance, peer relationship difficulties and language and cognitive delays, among others (Cicchetti & Valentino, 2006). While many of these behaviours reflect executive function difficulties, they also overlap with other self-regulatory problems (e.g., emotion regulation problems) and symptoms of maladaptive behaviour (e.g., aggression) (Espy, Sheffield, Wiebe, Clark & Moehr, 2011). Specifying the relation between environmental factors and EF has proven challenging, in part due to similarities between these related constructs. By examining the common versus distinct environmental effects on elements of EF and emotion regulation, this study provides a finer-grained characterisation of regulatory problems in this critical period of development.

1.2.1 Australian Context

Child maltreatment is a significant public health problem both globally and in Australia. Recent Australian data on child maltreatment indicated that 135,000 children in the country (26.1 per 1000 of the child population) received child protection services in 2012

(AIFS, 2012). It is particularly concerning that one quarter of these children were aged less than 5. Of the substantiated cases (7.8 per 1000), 42% of victims belonged to the lowest socio-economic group, and Indigenous children were disproportionately over-represented. In 2012–2013, \$3.2 billion was spent nationally on child protection and out-of-home care services, and a recent economic report estimates the financial impact of unresolved childhood maltreatment to be as high as \$9.1 billion per year (Kezelman, Hossack, Stavropoulos & Burley, 2015). The latter costing was based on lost revenue and welfare supports as a result of four main negative outcomes associated with childhood abuse in adults, including alcohol abuse, anxiety/depression, obesity and suicide/attempted suicide. In light of these sobering reports, there is a need to prioritise research and services for young children most at-risk of maltreatment in Australia.

1.2.2 Major Types of Maltreatment

The four major types of maltreatment are neglect, and physical, sexual and emotional abuse (Barnett, Manly & Cicchetti, 1993). Neglect includes failure to provide physical needs such as food, medicines and supervision. Physical abuse involves physical non-accidental injury resulting from such incidents as kicking, hitting and shaking. Sexual abuse involves sexual contact for the purposes of an adult's gratification, and emotional abuse involves the persistent thwarting of emotional needs by such actions as allowing a child to witness domestic violence, drug use or suicide threats (Barnett, Manly & Cicchetti, 1993). In Australia, emotional abuse is currently the most common substantiated abuse type, followed by neglect and physical abuse (AIFS, 2012).

Evidence suggests that different aspects of maltreatment (e.g., type, severity) have different relationships to child outcomes, with co-occurring types and chronic occurrence being more deleterious than singular, episodic maltreatment (English, Graham, Litrownik, Everson & Bangdiwala, 2005; Jaffee & Maikovich-Fong, 2011). To date, there is very little

data on whether executive function differences vary as a function of maltreatment multiplicity (frequency of maltreatment types) during the early childhood years from ages 3 to 6. Hence, research that delineates specific parameters of maltreatment type, severity, chronicity or onset can provide more information than studies that categorise maltreatment dichotomously (absence/presence) (Kim & Cicchetti, 2010; Manly, Kim, Rogosch & Cicchetti, 2001).

Despite the high incidence of maltreatment in young children, there are few evidence-based prevention/intervention models that specifically target this population. For example, a recent Australian review of parenting interventions for maltreated young children rated only five out of an identified 81 programs as ‘well supported’ or ‘supported’ (Parenting Research Centre, 2013). These five programs demonstrated sustained benefits for parents/children and were characterised by a focus on parent-child interactions, child health and safety. Effective delivery strategies included an individualised plan, structured sessions, sustained duration and consistent staff (Parenting Research Centre, 2013). Unfortunately, in practice, intervention services vary considerably in terms of program integrity and financial and personnel resources. Many services provide non-evidence-based programs that offer broad-based family support for minimising social risk, rather than dedicated parenting programs to reduce maltreatment (Tarabulsky et al., 2008). In view of this debate, research exploring the relational processes operating within maltreating families may inform intervention programs.

The literature on maltreatment (see Chapter 2 and sections 4.1, 5.1 and 6.1) has recommended numerous research priorities that have guided this study. First, previous studies of maltreated children have focused largely on aspects of emotion regulation rather than cognitive regulation or executive function (Maughan & Cicchetti, 2002). Due to the overlapping dimensions of executive function and emotion regulation and the processes that shape them, there is a need to examine both these domains within the same study (Ursache et

al., 2012). Second, due to the inherent difficulties in engaging high-risk families in research, few studies have endeavoured to examine relational processes in maltreating families (Tarabulsky et al., 2008). For example, multi-informant studies of maltreated children have relied mostly on case workers or teachers as key informants rather than on parents (Kim & Cicchetti, 2010). Given the primacy of the early parent-child relationship for children's emotional and cognitive development, it is valuable to engage parents' participation in studies of early child development (Lieberman, Chu, Van Horn & Harris, 2011). Finally, although child maltreatment is assumed to transcend social class, most studies of child maltreatment have been limited to children from low-income populations in which minority cultural groups are over-represented (Cicchetti, 2012). To address this gap in the literature, the present study included children from higher socio-economic groups to obtain a more diverse cross-section of children and to expand on prior research.

1.3 Executive Function in Early Childhood

Executive function enables children to think straight: to order their thoughts; to process information in a coherent way; to access details in short-term memory; and to avoid distractions or mental traps that detract from the task at hand (Blair & Razza, 2007). Children with inadequate executive function demonstrate poor monitoring and control of their thoughts and actions. This manifests in a child's impulsive behaviour, inability to concentrate, poor recall, inability to follow instructions, poor reasoning and planning, and inflexibility in adapting from one activity to another (Carlson & Moses, 2001). In young children, problems with concentration and impulsivity are difficult to disentangle from typical preschool behaviours. However, by using both behaviour rating scales and experimental measures of executive function, research can better capture individual differences in this complex developmental period (Espy et al., 2011)

1.3.1 Development of Executive Function

Executive function development is augmented by the genetically driven maturation of the prefrontal cortex system (dorsolateral, medial and orbitofrontal areas), but also is shaped by a child's unique social experiences that create this neural network. Compared to other brain regions, the prefrontal cortex and its connections (cortical and subcortical) mature late in the brain's developmental trajectory, making this network highly sensitive to environmental influences (e.g., maltreatment, stimulation), especially during phases of rapid development (Kolb et al., 2012; Pechtel & Pizzagalli, 2011). Executive function development is protracted: it emerges in infancy, experiences rapid growth in early childhood, matures in late adolescence and deteriorates in late adulthood (Diamond, 2013). In their review, Garon, Bryson and Smith (2008) proposed that executive function skills emerge in a hierarchical sequence, with each component building on existing abilities, with subsequent growth in executive function efficiency and accuracy. In early childhood, inhibitory control shows marked improvements, while in later stages other dimensions (e.g., planning) make improvements. Maturation of executive function also depends on the refinement of other executive and non-executive skills, including language and motor skills (Diamond, 2013).

The critical transition period of early childhood provides an opportune time for observing children's executive function. This is because individual differences emerge from 3 years of age (Wiebe et al., 2011), performance is highly variable (Garon et al., 2008) and individual differences are predictive of cognitive and social-emotional outcomes (e.g., Diamond, 2013; Espy et al., 2011). Early childhood is also arguably a period in which cognitive brain functions are most vulnerable to early stress or most sensitive to enrichment (Marshall & Kenney, 2009). In line with this view, Anderson et al. (2010) proposed that disruptions to neurocognitive development during the early stages of skills development result in more negative outcomes, while later disruptions when skills are more established are

less harmful. Therefore, identifying environmental factors that foster or undermine executive function during this period of high plasticity is relevant for the development of early intervention programs.

1.3.2 Developmental Significance of Executive Function

Executive function measured in early childhood is a robust predictor of numerous developmental outcomes in social competence, school readiness, academic achievement, behavioural adjustment and resilience (for reviews, see Carlson, Zelazo & Faja, 2013; Diamond, 2013). Early childhood executive function is related to the theory of mind or the understanding of true and false belief (Müller, Liebermann-Finestone, Carpendale, Hammond & Bibok, 2012), and is a robust predictor of school readiness and academic achievement (maths and reading) from preschool through to high school (Blair & Razza, 2007; Gathercole, Pickering, Knight & Stegmann, 2004). Executive function is also implicated in the development of common child disorders, including attention deficit hyperactive disorder (ADHD) (Pauli-Pott & Becker, 2011), and internalising and externalising behaviours (for a meta-analysis, see Schoemaker et al., 2012). Finally, preliminary research suggests that executive function may be important for children's resilience in adverse contexts such as homelessness (Masten et al., 2014).

From the perspective of intervention, there is emerging evidence that executive function can be improved through laboratory-based cognitive training or neurobiologically informed ecological interventions (Bryck & Fisher, 2012). Laboratory-based training involves repeated performances of tasks or computerised games that target a particular cognitive dimension, such as working memory, inhibitory control and cognitive flexibility. Research has highlighted that the quality of experience facilitated through executive function training can have a beneficial effect on child executive function. One study demonstrated that children as young as 3 years old who received explicit feedback when trained in executive

function tasks out-performed children who had general practice only without explicit feedback (Dowsett & Livesey, 2000). Although many studies of cognitive training have shown promising results, it remains unknown whether improved performance of specific cognitive functions as a result of training has generalised effects on real-world functioning (Bryck & Fisher, 2012).

Ecological interventions target the neural substrates of executive function through incorporating self-regulation, effortful control and working memory skills in school- or family-centred interventions (Bryck & Fisher, 2012; Diamond & Lee, 2011; Zelazo & Lyons, 2012). For example, findings from randomised control studies showed that classroom-based strategies that fostered children's structure, self-regulation, reflective thinking and metacognition resulted in higher executive function and school achievement compared to standard teaching methods (Bierman & Torres, in press; Blair, Raver, Granger, Mills-Koonce & Hibel, 2011; Diamond, Barnett, Thomas & Munro, 2007). Generally, it appears that programs that foster children's emotional regulation or executive function are more beneficial for improved child outcomes than the current focus on compensatory education, which results in short-lived academic gains only (Raver et al., 2011; Shonkoff, 2011). In summary, this research highlights the importance of executive function as a key construct in the study of child development and as an effective target for intervention.

1.3.3 Construct of Executive Function in Early Childhood

In the absence of a consensual definition of executive function, multiple terms have been used to refer to this complex cognitive construct, including executive, cognitive or attentional control, all of which infer control or coordination of other cognitive processes (Bull & Lee, 2014; Garon et al., 2008). The three core components that make up this set of cognitive processes include:

- Flexibility/shifting, which refers to the ability to move between alternative sets of mental operations.
- Inhibitory control, which refers to the ability to resist interference from competing or prepotent responses.
- Working memory/updating, which refers to the ability or capacity to refresh and maintain information in the presence of new information (Miyake et al., 2000).

In adulthood, these components are differentiated into a three-factor structure; however, in early childhood, the best evidence based on available measures for young children suggests a unitary structure, as these components are not yet divisible (e.g., Wiebe, Espy & Charak, 2008; Wiebe et al., 2011). It should be noted that other studies contradict these findings (e.g., Miller, Giesbrecht, Müller, McInerney & Kerns, 2012). Increasing evidence from a number of independent studies indicates that preschoolers' performance of tasks that putatively measure inhibition, working memory and cognitive flexibility reflects more of a single, latent structure than a two-factor structure that emerges in middle childhood (Wiebe et al., 2011). This unitary structure of executive function in early childhood reflects the systems neuroscience view of the prefrontal system's fundamental modulatory role in exerting ongoing 'top-down' control by biasing activity in task-specific neural pathways, in contrast to opposing 'bottom-up' information from other neural areas (Miller & Cohen, 2001).

Researchers also argue that executive function can be differentiated into 'hot' and 'cool' types. Hot executive function, assessed by emotional-laden tasks, is thought to be related to the orbitofrontal prefrontal cortex and behavioural functioning, whereas cool executive function, assessed by affectively neutral tasks, relates more to the dorsolateral prefrontal cortex and academic functioning (Zelazo & Carlson, 2012).

In the absence of a standard definition of executive function, and given the lack of agreement on its early structure, there have been challenges in the development of executive function measures (Willoughby, 2013). The more traditional neuropsychological method of measuring executive function involves individually administered ‘cool’ cognitive tasks in the laboratory. Many of these tests are experimental, with limited norms, reliability and validity for determining normal from abnormal executive function abilities in young children. According to Anderson and Reidy (2012), there are few validated, norm-referenced test batteries that allow for a comprehensive assessment of executive function in preschoolers (for an exception, see Weintraub et al., 2013). More recently, caregiver/rating questionnaires have been designed as an ecological approach to measuring behavioural manifestations of preschoolers’ executive function in real-life settings (Isquith, Crawford, Espy & Gioia, 2005). However, there is some contention among executive function researchers on the agreement between these methodologies and whether they measure the same executive function construct. In light of this unresolved question, Chapter 4 of this thesis is the first study to examine the association between performance-based and caregiver rating measures of executive function in a sample of maltreated and non-maltreated children (for a review of related studies, see Toplak, West & Stanovich, 2013).

1.3.4 Executive Function and Self-Regulation

Executive function is considered a cognitive domain that falls under the rubric of self-regulation or self-control, a rubric comprising processes that enable optimal levels of emotional, motivational and cognitive arousal (Duckworth, 2011; Liew, 2012). Another aspect of self-regulation is the control or regulation of one’s emotions, which can be measured in terms of temperament and attention (effortful control) or social-emotional wellbeing (e.g., emotion regulation) (Eisenberg et al., 2010; Ursache et al., 2012). The similarities between effortful control and executive function can lead to confusion,

particularly as both constructs involve inhibitory control (Liew, 2012). While there are similarities between these constructs (see Chapter 2), this study will focus on executive function in preference to effortful control, as the latter construct is more aligned with the study of temperament or personality. This focus does not ignore new theoretical models of self-regulation, which propose that emotion, motivational and cognitive processes operate interdependently under the same integral, broad construct of self-regulation (Berkman, Graham & Fisher, 2012; Calkins & Marcovitch, 2010; Ursache et al., 2012). Such new models provide the impetus for study 3 of this thesis, which examines the common versus distinct environmental factors related to the development of cognitive and emotion regulation (Calkins & Marcovitch, 2010).

1.4 Ecological Factors Influencing Executive Function Development

The ecological-transactional model of human development provides a theoretical framework for investigating the impact of maltreatment on child executive function. Substantial executive function research has concentrated on theoretical or developmental issues (Friedman et al., 2008; Garon et al., 2008; Hughes, 2011), with fewer studies investigating environmental factors (Bernier, Carlson & Whipple, 2010; Hughes & Ensor, 2009). According to the ecological-transactional perspective of human development (Bronfenbrenner & Morris, 1998; Cicchetti & Valentino, 2006), child cognitive development is influenced by a combination of multilevel biological, psychological and environmental factors embedded within a child's ecologies; these factors vary depending on their proximity to the child (Carlson et al., 2013; Hughes, 2011). Cicchetti & Valentino (2006) proposed that factors most proximal to the child (e.g., maltreatment, parental depression) interact with other distal factors (e.g., socio-economic status [SES], ethnicity) to undermine normal developmental processes in maltreated children. Conversely, the presence of protective factors at any level of a child's ecology may promote adaptation and may provide an

explanation of why some children achieve successful outcomes in the face of maltreatment (Cicchetti, 2012). The selection of specific micro-system (family), macro-system (culture/social class) and ontogenic (individual child) factors in the present study was guided by assessment of their theoretical relevance to executive function development. These factors will be broadly described below, with further discussion to be found in Chapters 4–6.

The process of early self-regulation is influenced by genetics and maturity as well as environmental factors within a child's micro-system, including the parent-child relationship and parenting (Shonkoff, 2010). Although evidence suggests that individual differences in executive function reflect substantial genetic contributions (Friedman et al., 2008), there is much to learn about the relationship between parenting and executive function. Parenting or caregiving can be assessed on a spectrum, which ranges from nurturing, responsive caregiving to neglectful or abusive interactions (Shonkoff, 2010).

1.4.1 Parenting Influences on Executive Function

Parenting practices refers to a wide typology of behaviours involving dynamic, interactive processes which are believed to contribute to the course and outcome of child development (O'Connor, 2002). The findings from the systematic review in Chapter 2 provide collective evidence that parenting behaviours of scaffolding, stimulation, sensitivity, behavioural control/discipline are associated with individual differences in executive function in low-risk samples of children. In respect to high-risk families, an experimental study with maltreated preschoolers demonstrated that foster parents' enhanced sensitivity following parent training resulted in the improvement of foster children's executive function (Lewis-Morrarty, Dozier, Bernard, Terracciano & Moore, 2012). On the basis of these findings, there is reason to expect that parenting behaviours beyond these broad parenting styles are also relevant when seeking to understand the links between family relational processes and child regulation problems in high-risk children (Belsky & de Haan, 2011).

In this vein, researchers have proposed that parents socialise their child's emotions or emotion regulation via emotion-related socialisation behaviours (ERSBs) (Eisenberg, Cumberland & Spinrad, 1998; Morris, Silk, Steinberg, Myers & Robinson, 2007). Morris identified five ways parents socialise their child's emotion regulation: 1) emotion coaching (guiding children regulating emotions); 2) parental reactions to emotions (negative or positive reactions); 3) parental encouragement and control over emotion (optimal level of parental control over child's emotional expression); 4) teaching emotion regulation strategies (e.g., distraction, breathing techniques), and 5) niche picking (parents' selecting/avoiding opportunities for children to experience emotional stimuli) (Morris et al., 2007). In addition to the influences from the broader family context, other parental factors (e.g., mental health), child characteristics (e.g., temperament) and developmental status (e.g., age) were also hypothesised to influence ERSBs. In the model of emotion socialisation, ERSBs were thought to directly influence child emotion regulation (or effortful control) and subsequent behaviour (Eisenberg et al., 1998; Morris et al., 2007). The limited research in emotion socialisation in maltreating families has focused on the effects of parental emotion coaching (Shipman et al., 2007; Shipman & Zeman, 2001) on emotion regulation in school-aged children. Thus, to extend this field of research, the studies in Chapters 4, 5 and 6 examine the role of parents' reactions in the development of executive function in maltreated preschoolers.

Studies which explore the promotive and protective role of parents in raising healthy children in adverse contexts can inform the design of therapeutic interventions. There has been increasing attention given to the characteristics of parenting which foster children's positive outcomes in contexts of poverty (Belsky & de Haan, 2011; Doan & Evans, 2011). For example, one study of homeless families residing in a shelter found that children (4–7 years) with more sensitive parents had better executive function and school achievement than

those with parents who were less responsive (Herbers et al., 2011). As reported in Chapter 6, relatively few studies have examined how differences in parenting within the specific context of maltreatment relate to differences in child outcomes. This research seeks to clarify the specific risk and protective factors of parenting which are associated with maltreated children's executive function. This will contribute to research into resilience, which seeks to understand why some children achieve positive outcomes despite exposure to maltreatment (Cicchetti, 2012).

1.4.2 Maltreatment and Executive Function

Child maltreatment is an extreme form of problematic parenting and a well-established, environmentally mediated risk factor for psychopathology (Belsky, 1993; Rutter, 2012). The neurobiological model of early adversity provides a widely accepted framework for understanding how adverse parenting is associated with children's cognitive and emotion regulation (De Bellis, 2005; McEwen, 2012). According to this model, maltreatment evokes a child's sense of threat, fear or anxiety, which is processed through the sensory system and produces cascading alterations in physiological stress responses (hypothalamic-pituitary-adrenal axis, sympathetic and parasympathetic nervous systems)—a phenomenon known as allostasis (McEwen, 2012; Teicher et al., 2003). These stress responses lead to changes in the child's neural systems that subserve learning, memory (e.g., hippocampus) and executive function (prefrontal cortex system) (De Bellis, 2001; Fox, Levitt & Nelson III, 2010). Specifically, stress hinders the prefrontal cortex system's inhibitory effect on amygdala activation, which in turn minimises feedback control systems (e.g., hypothalamic-pituitary-adrenal axis) that serve to control stress and enable the prefrontal cortex system's role in self-regulation (Kolb et al., 2012). It follows, then, that in the context of a malevolent home environment, children who are exposed to aggression or psychological intimidation are more likely to experience heightened emotional arousal (e.g., hypervigilance, hyperactivity,

numbing) that disrupts their volitional attention, thought and executive function. Though these conditioned responses may be temporarily adaptive to the hostile environment, they constrain a child's flexibility in learning and adaptation to other contexts (Cicchetti, 2002; McCrory, De Brito & Viding, 2010).

Empirical support for this model comes from neuroscience studies that have found structural, neurochemical and electrophysiological markers of brain changes in maltreated and institutionalised older children (Hart & Rubia, 2012; McCrory et al., 2010; McDermott, Westerlund, Zeanah, Nelson & Fox, 2012). Surprisingly, there are fewer studies that provide evidence for maltreatment-associated changes in brain behaviour, particularly cognitive functioning of younger children (Hedges & Woon, 2011; McCrory et al., 2010). Chapter 4 of this thesis details how studies that have found associations between maltreatment and higher cognitive abilities of executive function have been largely focused on extreme cases of maltreatment in which children were removed from parental care. Such findings are difficult to generalise to children who experience lower levels of maltreatment and who remain with their families (Belsky & de Haan, 2011). Thus, a more specific focus is required to examine executive function in preschoolers exposed to less severe maltreatment, who represent the growing cohort of children referred to child protection or early intervention services. Thus, Chapter 5 reviews the literature and addresses this gap in the research.

1.4.3 Parental Depression and Executive Function

Few studies of executive function have investigated whether parental depression affects child executive function, despite the large body of research supporting a negative association between parental depression, parenting and child outcomes (Lovejoy, Graczyk, O'Hare & Neuman, 2000). One recent longitudinal study found that infants' exposure to both average and prolonged maternal depression was predictive of poor executive function performance four years later, even after controlling for executive function stability, maternal

education and parenting (Hughes, Roman, Hart & Ensor, 2013). In contrast, Rhoades et al. (2011) found no generalised association between parental depression and child executive function, although depression contributed to poor executive function in interaction with other social risk factors. Other studies suggested that younger children, in comparison to school children, are more susceptible to the effects of parental depression due to their dependence on their parents (Choe, Olson & Sameroff, 2013; Micco et al., 2009). Together, findings from these few studies highlight the importance of considering parental depression as a potential predictor of child executive function, particularly in maltreating families who are characterised by high levels of parental depression (White et al., 2014)

1.4.4 Socio-Economic Status and Executive Function

Social class values indexed by income, parental education or employment permeate the home environment and influence child development either directly or through proximal parenting processes (Taylor, Repetti & Seeman, 1997). Thus, it is not surprising that SES disparities are robust in child executive function development (for a review, see Hackman, Farah & Meaney, 2010). SES-related differences in working memory and inhibitory control have been observed in infancy and early and middle childhood (e.g., Noble, McCandliss & Farah, 2007; Sarsour et al., 2011). There are also SES-related differences in neural systems (event-related potential) and brain structures underlying executive function development (e.g., Noble, Houston, Kan & Sowell, 2012).

Several theoretical perspectives highlight why SES in early childhood may be associated with executive function. First, the parental investment model explains that economic wellbeing will be positively related to enriched, structured and calm home environments that encourage child learning and executive function (Conger & Donnellan, 2007; NICHD, 2005; Valiente, Lemery-Chalfant & Reiser, 2007). Second, the family stress model predicts that economic hardship affects family functioning (e.g., domestic violence)

and parental adjustment (e.g., parental mental health), which in turn diminishes parenting quality and subsequent child outcomes (Belsky & de Haan, 2011). Indeed, studies have identified associations between executive function and numerous family-level correlates of low SES, including parental depression, family instability or family risk factors (Blair, Raver et al., 2011; Brown, Ackerman & Moore, 2013; Hughes et al., 2013). Lower levels of responsive caregiving have been shown to partially mediate SES effects on child executive function in numerous studies (Blair, Granger et al., 2011; Rhoades et al., 2011).

These findings provide solid support for the negative association between low income and child executive function, and highlight the need to examine markers of SES (e.g., maternal education) in addition to the proximal processes of maltreatment and parenting through which SES risk can be transmitted. As Chapter 5 demonstrates, to date no study of maltreated preschoolers has examined the complex interplay among family, contextual factors and child executive function.

1.4.5 Child Characteristics and Executive Function

Research has consistently found significant relationships between verbal ability and executive function performance among preschoolers (e.g., Fuhs & Day, 2011; Hongwanishkul, Happaney, Lee & Zelazo, 2005; Matte-Gagne & Bernier, 2011). One explanation for this relates to the Vygotskian principle of self-regulating speech: children who have more proficient verbal ability are more able to use self-talk or self-labelling for goal-directed behaviours (Fuhs & Day, 2011). Thus, it is important to consider verbal ability in executive function studies.

Prior research has reported that gender is related to executive function performance, with most evidence favouring a gender advantage for girls in early childhood, especially in respect to inhibitory control and working memory (e.g., Carlson & Wang, 2007; Wiebe et al., 2008). Nonetheless, some studies have shown no gender differences (Davidson, Amso,

Anderson & Diamond, 2006; Hughes, Ensor, Wilson & Graham, 2010), which underscores the importance of considering gender differences in executive function studies.

Cultural background and language/s spoken may also interact with risks of maltreatment in relationship to child executive function. Research indicates cross-cultural differences in child executive function, particularly evident in studies comparing Asian and American children (Lewis et al., 2009; Oh & Lewis, 2008). Studies also suggest a ‘bilingual’ advantage in executive function development, with bilingual children developing earlier executive function and performing better in dual-task executive function measures in comparison to monolingual children (for a review, see Bialystok, Craik, Green & Gollan, 2009). Bialystok (2011) proposed that the bilingual advantage is best explained by an enhanced coordination over the various executive function components, possibly due to a more enhanced neural network. Further, cultural background may influence the impact of ecological risk on executive function development. Certain family practices or social risks may be more pertinent in some cultural groups compared to others. For example, studies have found that the risk of harsh parenting on subsequent child executive function is less evident in African American families than Caucasian American families (Holochwost, 2013; Rhoades et al., 2011). Further, Rhoades et al. (2011) found that the risk of poverty on child executive function varied according to cultural background. Similarly, data from child maltreatment reports indicate that some ethnic groups, including Indigenous children, are at higher risk of maltreatment than others (AIFS, 2012). It is likely that the ecological risks of low SES, minority cultural background and child maltreatment may overlap; therefore, it is important to differentiate the contributions of these individual factors to executive function where possible.

1.5 Rationale for the Present Study

Early childhood is a time of both opportunity and risk, when social influences shape the establishment of cognitive and emotion processes that determine subsequent long term outcomes (Clark et al., 2013; Moffitt et al., 2011; Ursache et al., 2012). Child maltreatment poses a significant environmental risk factor for early childhood development (Rutter, 2012). Although there has been a growth in studies examining the effects of adversity on child executive function and self-regulation, a number of questions remain—these provide the impetus for this study.

First, few studies to date have examined executive function in at-risk preschoolers from troubled families referred to child protection services. This degree of family-level maltreatment is presumed to be quite different from the severe environmental deprivation encountered by older children in orphanages, reported in prior research (Belsky & de Haan, 2011). Moreover, the construct of executive function in early childhood is much less differentiated than in school-aged children (Wiebe et al., 2008); hence, prior findings of executive function problems in studies of older maltreated children may not be comparable to younger cohorts.

Second, studies of child maltreatment have rarely investigated other relational aspects of the parent-child relationship besides the maltreatment experience (Cicchetti, 2012). Based on this thesis' systematic review of parenting and executive function (see Chapter 2), there is strong justification for examining the association between less-studied domains of parenting and executive function in a novel sample of children. Given that only two prior studies have investigated whether positive parenting moderates the risk of maltreatment on preschoolers' executive function, this study will build on these important findings (Cipriano-Essel, Skowron, Stifter & Teti, 2013; Kim-Spoon, Haskett, Longo & Nice, 2012). Examining the

potentiating or compensatory roles of parenting on child executive function can guide parenting interventions for maltreated children.

Third, although there is evidence that both proximal and distal ecological risk factors (low income, maternal depression, cultural background) are associated with executive function development, no study to date has considered these influences in the context of a more potent and proximal risk factor—childhood maltreatment.

Fourth, no studies involving maltreated children have used both performance-based and caregiver ratings of executive function in order to ascertain their convergence or test for factors that moderate this association. Prior studies that found limited agreement between these two executive function measurement approaches were conducted on clinical samples of children (e.g., ADHD, brain injury). This leads one to question whether the degree of executive function impairment may have accounted for their findings (Silver, 2000); thus, this thesis provides a comparison sample to test this possibility.

1.6 Aims of the Present Study

The overarching aim of this research was to test whether child maltreatment, in combination with parents' ERSBs and child/family factors, potentiates or undermines executive function in early childhood. The specific research components through which this was addressed are presented in the following chapters:

1. Chapter 2 comprises a systematic review (Fay-Stammbach, Hawes, & Meredith, 2014), which aimed to examine current evidence regarding associations between parenting and EF in early childhood. More specific aims were to identify the specific parenting behaviours that have been most consistently associated with individual difference in executive function, the risk and protective factors that moderated this association, and the processes by which the influences of parenting on executive function are mediated.

2. The aim of Study 1 (see Chapter 4) was to assess the association between two distinct methods for assessing executive function in early childhood, and to examine whether environmental factors – in particular, maltreatment – moderate this association. Caregiver rating scales and performance-based measures of executive function are compared in a sample of maltreated and non-maltreated preschoolers, and maltreatment (multiplicity of types) is tested as a possible moderator of this association.
3. The aim of Study 2 (see Chapter 5) was to examine whether maltreatment and child and family-level factors (e.g., ethnicity, parental depression) predict child executive function, and whether the strength of these relationships is moderated by ERSBs.
4. The aim of Study 3 (see Chapter 6) was to examine common versus distinct environmental correlates (maltreatment, ERSBs and family factors) of emotion regulation versus cognitive regulation (i.e., executive function). Here, the moderating role of ERSBs on emotion and cognitive regulation was further examined in order to better understand developmental malleability and the potential for achieving change through parenting.

1.7 Thesis Outline

This chapter provided a background to the study, outlined the rationale for the investigation, and introduced the research aims. Chapter 2 presents a review of the literature, while Chapter 3 describes the common features of the methodology used across the studies. The three studies are then presented in Chapter 4 to Chapter 6, each containing distinct literature reviews, methodologies, results and conclusions. Chapter 7 concludes the thesis, summarises the major findings and highlights implications for further research.

Chapter 2: Literature Review—Parenting Influences on Executive Function in Early Childhood

This chapter reviews 23 studies that explore common parenting influences on executive function in early childhood. The emergence of control over attention, cognition and behaviour is one of the core achievements of early development, and underpins a range of developmental domains associated with academic achievement, socio-emotional competence and resilience (Carlson et al., 2013). As discussed in the previous chapter, executive function comprises specific higher-order processes (e.g., inhibitory control, cognitive flexibility or shifting, and working memory) that enable goal-directed action and adaptive responses to novel or ambiguous situations (Hughes et al., 2005). These self-regulatory capacities depend on maturational processes but also are shaped by the child's many contexts or ecologies, particularly the parent-child relationship. This thesis has selected preschoolers as the group under study because executive function rapidly emerges during early childhood, underpinned by heightened neural plasticity in the prefrontal cortex system (Kolb et al., 2012).

Furthermore, preschoolers are particularly dependent on caregivers for stimulation, nurturance and regulation prior to their entry into school and socialisation through broader social contexts (Sameroff, 2010).

While extreme disturbances in caregiving (e.g., maltreatment) and other environmental issues are associated with deficits in executive function early in life (e.g., Pechtel & Pizzagalli, 2011), little is known about the influences of more common parenting processes on executive function. Therefore, this chapter reviews the research as it pertains to three questions:

1. Is quality of parenting associated with early childhood executive function?

2. What risk or protective factors moderate associations between parenting and executive function?
3. Through what mechanisms does parenting operate on executive function across early childhood?

2.1 Theoretical Perspectives on Parenting and Executive Function

Researchers are only now beginning to develop models of executive function that reflect an ecological perspective on child development. In so doing, they are starting to recognise that executive function represents a constellation of processes that emerge as the output of many neural systems, and that plasticity in these systems is greatest early in life (Diamond, 2013). In contrast to prior models of executive function that have focused on either genetic factors (biological maturation theory; Friedman et al., 2008) or socialisation processes (socio-cultural theory; Lewis et al., 2009), emerging ecological models assume that executive function is embedded within a combination of multilevel biological and contextual processes (Zelazo, 2013).

Parenting behaviours most consistently associated with individual differences in executive function can be grouped into four theoretically derived dimensions (Landry & Smith, 2010; O'Connor, 2002): scaffolding, stimulation, sensitivity/responsiveness versus hostility/rejection, and control. As emphasised in socio-cultural theories, parental scaffolding (e.g., verbal or physical guidance) involves deliberate efforts by parents using either verbal or nonverbal actions to help children engage with a challenging activity (Lewis & Carpendale, 2009). This classification also includes autonomy support or granting parents' encouragement of children's opinions, choices, decisions, and problem solving (Matte-Gagne & Bernier, 2011). Parental stimulation involves providing children with opportunities to develop cognitive skills through enriched interactions including reading to children (Bradley, McKelvey & Whiteside-Mansell, 2011). As conceptualised in attachment theory, sensitive/

responsive caregiving (e.g., positive affect, warmth, absence of hostility) is assumed to promote the internalisation of regulatory strategies (Bernier, Carlson, Deschenes & Matte-Gagne, 2012). Hostility/conflict or rejection is defined by affective behaviours with a negative, critical, or rejecting tone (e.g., negative affect, intrusiveness), and consistent with the studies discussed here, is often viewed as the opposite of the sensitive/ responsive caregiving dimension (O'Connor, 2002). Finally, social-cognitive theories posit that a child's regulatory capacities may be promoted through supportive behavioural control or discipline (e.g., authoritative) or undermined by negative control (harsh discipline; Grolnick & Pomerantz, 2009).

2.1.1 Key Variables and Definitions

This chapter focuses on studies that include: 1) a direct measure of parenting towards a target child, as defined later; 2) a discrete measure of children's executive function, as opposed to overlapping temperament-based constructs including effortful control; 3) data on associations between parenting and children's executive function variables; and 4) participants from 2 to 6 years (± 6 months). Despite much research into the effects of environmental factors on the development of executive function, there is little understanding of the effects that can be attributed to parenting per se. Contexts of extreme adversity may be characterised not only by compromised caregiving but also a range of other environmental inputs (e.g., maltreatment) that likely also shape executive function (Pechtel & Pizzagalli, 2011). Likewise, several neurodevelopmental disorders and conditions (e.g., attention deficit hyperactivity disorder, prematurity) are characterised by deficits in executive function that emerge somewhat independently of parenting. To draw interpretations about the specific contributions of parenting to the development of executive function, this review excluded studies of children with neurodevelopmental conditions and from adverse contexts (e.g., homelessness, maltreatment).

Researchers have defined executive function as a centralised unitary construct, a construct with many components, or a unitary construct with dissociable components (e.g., Garon et al., 2008; Wiebe et al., 2011). Although researchers agree that the subcomponents of executive function differentiate increasingly with age, there is a lack of consistent evidence about the structure of executive function in early childhood (e.g., Miller et al., 2012; Willoughby, Pek, Blair & Family Life Project, 2013).

This thesis considers all existing executive function constructs as operationalised within specific studies. For example, some of the paradigms used to operationalise executive function in the reviewed studies index inhibitory control, while others are tailored towards working memory and cognitive flexibility, each of which may vary in the extent to which they reflect the latent construct of executive function in early childhood (Anderson & Reidy, 2012; Miller et al., 2012). Given that components of executive function (e.g., working memory) and general intelligence are often correlated, researchers have often controlled for intelligence (or verbal ability) in analyses of the relationship between executive function and various correlates. On the basis of the findings from such research, it is recognised that executive function contributes to child development independent of general intelligence and other covariates, including SES (e.g., Blair, Granger et al., 2011).

The measures of parenting included in this chapter encompass observations, questionnaires, and interviews, specifying caregiver behaviours that are directed towards a specific child (e.g., stimulation), as opposed to parents' personal characteristics (e.g., maternal depression; O'Connor, 2002) or attitudes towards parenting. This chapter classifies parenting variables according to study authors' definitions, and their best fit within the four parenting dimensions outlined earlier.

2.2 Search Strategy

To identify studies investigating parenting behaviours and executive function, a systematic computer search was conducted of the databases of PubMed, Web of Science, PsychInfo and Social Science Theses. The search combined the terms: executive function (i.e., executive control, cognitive control, working memory, inhibition, inhibitory control, cognitive flexibility, shifting, attentional regulation, planning), parenting (i.e., parenting styles, parent-child relationships, maternal or paternal, parenting styles, maternal or paternal childrearing), and preschool (early childhood, young children). Where possible, these terms were ‘exploded’ and all English, refereed journal articles, and ‘grey’ literature, published up to the year 2013 were included. Search limitations for age, ‘infancy’ and ‘2–6 years’ were set in the PsychInfo, Pubmed data bases, while no age limits were possible for the Web of Science. Additional reference trails to key authors were also conducted. To increase search capabilities, the final set of studies (182 from PsychInfo, 247 from Medline, 344 from Web of Science and eight from Social Science Theses) were manually sorted. Studies were retained if they corresponded to the aims and met inclusion criteria. Typically, duplicate articles, and studies that used effortful control measures, or sampled children with developmental diagnoses, or examined non-direct parenting behaviours parenting, were excluded. These steps produced a pool of 23 studies that met inclusion criteria whose characteristics are listed in Table 2.1.

2.2.1 Inclusion/Exclusion Criteria

This review focused on studies that included: 1) a ‘direct’ measure of parenting towards a target child, that was characterised by parental behaviour as opposed to a parental characteristic (e.g., depression) or a parental belief or attitude; 2) a discrete measure of child executive function, as opposed to overlapping temperament-based constructs (e.g., effortful control, self-regulation); 3) data on associations between parenting and child executive

function variables; and 4) participants aged 2–6 years ($\pm$ 6 months). In order to focus on individual differences in executive function that may be attributable to the parenting variables of interest, studies were excluded when focusing on samples that are developmentally atypical with respect to child characteristics (e.g., ADHD, low birth weight) or context (e.g., foster care, deprivation).

2.2.2 Characteristics of Studies

A total of 18 longitudinal and five cross-sectional studies met the inclusion criteria, the study characteristics of which are presented in Table 2.1. Collectively, these studies which originated predominantly from North America, Canada, and the United Kingdom reported data on 5053 parent-child dyads. This is a conservative calculation as some studies used the same dataset or a core of the original sample for a subsequent follow-up study. Sample sizes ranged from $N=49$ to $N=1292$. The mean age of child participants was 47 months, with most studies sampling males/females equitably. For the most part, these studies indexed executive function through a combination of three or more tests, with most studies defining the early childhood executive function construct as a single composite score, with fewer studies using a two-factor structure. A wide variety of parenting measures were used across the parenting dimensions examined. Those that indexed parental measures of sensitivity (or hostility) and scaffolding used largely observational measures coded by observers. The measures that indexed parental stimulation used a combination of observation, interview and self-report methods, while parental control measures were commonly self-report questionnaires. Studies that met the search criteria were examined in relationship to the three core questions.

Table 2.1

Characteristics of Included Studies

Authors	Purpose of study	Sample size (N)	SES (L,M,H) Race (mixed)	Child female ratio (%)	Mean child age at executive function assessment (months)	Measure of parenting Home or lab: free or structured task	Executive function domain; Measures	Child covariate: IQ/ language
<i>Longitudinal studies</i>								
Bernier et al. (2010)	Are there prospective links between quality of parenting at 12 & 15 months of age with child executive function at 18 & 26 months?	80	M	55	26.3	Maternal sensitivity MBQS (O); Maternal mind-mindedness (O); Maternal autonomy support (O) Home: mother-infant free play, problem-solving puzzle	Impulse control (delay of gratification); Executive function conflict (Spin the Pots, Shape Stroop, Baby Stroop)	Yes
Matte-Gagne & Bernier (2011)	What are longitudinal relationships among maternal autonomy support, children's language and 3 year child executive function? Does children's language mediate effects of parenting on later executive function?	53	M	64	26.3 & 36.9	Maternal autonomy support; (O) Home: problem-solving task (2 puzzles)	Executive function conflict (Bear/Dragon, Day/Night, DCCS); Impulse control (delay gratification)	Yes
Bernier et al. (2012)	Are composite scores of parenting and child attachment related to child executive function?	62	M	61	26.3 & 36.9	Child attachment security Attachment Behaviour Q-Sort (O); Parent-child interactions (maternal sensitivity, maternal mind-mindedness,; Maternal autonomy support, father-child interactions), see above Home: parent-infant free play, problem-solving puzzle	Executive function conflict (Bear/Dragon, Day/Night, DCCS); Impulse control (delay gratification)	Yes
Bindman et al. (2013)	What is the relationship between preschoolers; emergent executive function and parental management language?	127	M mixed	50	52.8	Parental management language (O); (suggestive & directive statements) Home: joint parent-child imaginative play scenario (birthday party)	Executive function (Heads-Toes-Knees-Shoulders)	No

Authors	Purpose of study	Sample size (N)	SES (L,M,H) Race (mixed)	Child female ratio (%)	Mean child age at executive function assessment (months)	Measure of parenting Home or lab: free or structured task	Executive function domain; Measures	Child covariate: IQ/ language
Blair et al. (2011)	Does cortisol and parenting in first 2 years account for poverty's effect on 3 year cognitive ability (executive function and IQ)?	1292	L mixed	50	36	Maternal Positive (O); (detachment, pos regard, animation, stimulation) &; Maternal negative (O); (intrusiveness, negative regard) Home: Free play (infancy), book reading & puzzle (24 mths)	Executive function (span like working memory, Item Selection task, Spatial Conflict, Go-No-Go)	Yes
Clark et al. (2013)	What is the relationship of child gender, early learning resources and parent social stressors on children's growth in inhibitory control and cognitive flexibility?	388	L,M,H	50	35	Learning resources: subscales of HOME EC (I, O) & Life Stressors and Social Resources Inventory—LISRE; (Q) Home: child observed in natural, unstructured context	Inhibitory control & cognitive flexibility: (The Shape School Test)	No
Conway & Stifter (2012)	Do maternal attention maintaining & directing behaviours and temperament at 2 yrs predict 4 yr executive function?	68	M	50	55	Maternal attention directing and maintaining (O); Lab: structured (replicating Lego)	Conflict inhibition; (three pegs, Day-Night Stroop, peg tapping); Delay inhibition (delay gratification, dinky toys)	No
Cuevas et al. (2014)	What are the relative contributions of maternal executive function and caregiving to child executive function from 10 to 48 mths?	62	M	59	46	Composite of Negative Parenting (O) (Intrusiveness, negative affect, physical stimulation, failure to facilitate attention).; Lab: Toys task, peek-a-boo (infancy), puzzles (toddlers)	Executive function composite 4 yrs: (Simon says, Yes-no, DCCS)	Yes
Hackman (2013)	Does parental stimulation (home environment), maternal sensitivity or life stress mediate effects of SES on executive function components between 4.5 and 11 years old?	1009	L, M, H Mixed	50	54	Maternal sensitivity composite (O); Infant measure (sensitivity, intrusiveness, positive regard, supportive presence) or Preschool measure (hostility, respect for autonomy).; Cognitive stimulation (O); (number and quality of stimulating behaviours)	Attention and impulsivity; (Continuous Performance Task); Working memory (Woodcock- Johnson Memory for sentences); Planning (Tower of Hanoi)	Maternal IQ

Authors	Purpose of study	Sample size (N)	SES (L,M,H) Race (mixed)	Child female ratio (%)	Mean child age at executive function assessment (months)	Measure of parenting Home or lab: free or structured task	Executive function domain; Measures	Child covariate: IQ/ language
						Home Inventory (O, I) full scale; child observed in natural, unstructured context		
Kraybill & Bell (2013)	Are their associations between maternal behaviours at 10mths, infant frontal brain electrical activity and 4 and 6 yrs. executive function?	56	M	46	48	Maternal Positive Affect (O); Lab: structured play with infant toys	Executive function composite: No 4 yrs; (Pig/Bull, DCCS, Yes/No); Executive function at 6 yrs—parent report (BRIEF-P)	
Hammond et al. (2012)	Does early parental scaffolding at 2 & 3 years relate to 4-year executive function?	82	M	46	48	Maternal scaffolding (O); Laboratory: structured task—solve four ring puzzle	Executive function Spatial working memory (e.g., Delayed Alternation, Spatial Span); Executive function Conflict (e.g., Bear-Alligator, Reverse Categorisation)	Yes
Hughes & Ensor (2009)	What are the relative associations between different parenting influences on 2 & 4-year-old executive function?	125	L, M, H	38	48	Global positive (O & Q); Global negative (Q); Imitative learning (O); Maternal scaffolding (O) Home: structured play, tidy up	Executive function composite; (Spin the Pots, Baby Stroop, Bead task, Detour Reaching or Tower of London)	Yes
Holochwost (2013)	Do parenting behaviours mediate the relationship between cumulative risk and executive function?	206	L, M, H Mixed	48.5	60	Maternal sensitivity composite (O) (Sensitivity/responsiveness, detachment/disengagement, positive regard, animation, stimulation).; Negative intrusiveness composite (O); (negative regard, intrusiveness) Home: free play	Executive function composite; No (Day-Night Stroop, McCarthy Digit Span, Flexible Item Selection Task)	
Mezzacappa et al. (2011)	Does pre-natal smoking and learning stimulation at 6 mths predict executive function at 5 & 6 years?	249	L, M, H Mixed	47	70.8	HOME—Infant Toddler (Learning stimulation scale) (O,I) Home: free play	Executive function, executive control (Attention Networks Test)	No

Authors	Purpose of study	Sample size (N)	SES (L,M,H) Race (mixed)	Child female ratio (%)	Mean child age at executive function assessment (months)	Measure of parenting Home or lab: free or structured task	Executive function domain; Measures	Child covariate: IQ/ language
NICHHD (2005)	To what extent does parental stimulation and sensitive caregiving in the home compared to childcare or school relate to differences in children's attention, memory and planning?	727	L, M, H Mixed	49.4	83.7	Maternal sensitivity composite (O); Infant measure (sensitivity, intrusiveness, positive regard, supportive presence) or Preschool measure (hostility, respect for autonomy); Cognitive stimulation (O); (number and quality of stimulating behaviours) Home Inventory (O, I) full scale;	Sustained attention and impulsivity; (Continuous Performance Task); Working memory (Memory for sentences); Planning (Tower of Hanoi)	Maternal verbal ability
Rhoades et al. (2011)	Do demographic and familial risks during infancy predict executive function competence at 36 months of age?	1155	L Mixed	50	36	Positive engagement (O); (detachment, pos regard, animation, stimulation) &; Negative intrusiveness (O); (sensitivity, intrusiveness, negative regard) Home: free & structured	executive function composite of three tasks (span type working memory, Flexible item selection task of attention shifting, Simon task for inhibitory control)	Yes
Roskam et al. (2013)	What impact does child personality/ inhibition and parenting/ attachment have on externalising behaviours between 3–5 years?	161	M,H	39	52	Supportive and controlling parenting ratio (Q)	Inhibition composite (three blobs, Luria's hand game, Card sort, Cat dog, fish, Monsters Stroop, Nepsy Statue)	No
Weber (2011)	Do other psychosocial factors including SES, parental practices (parental disciplinary practices) and cultural beliefs predict executive function in children?	67	Mixed	58	75	Parenting Relationship Questionnaire (Reynolds & Kamphaus, 2006) (Q); (Discipline practices)	Cool executive function (Nepsy Tower Task, Day-Night Task); Hot executive function (Delay of gratification, Less is more)	No

Authors	Purpose of study	Sample size (N)	SES (L,M,H) Race (mixed)	Child female ratio (%)	Mean child age at executive function assessment (months)	Measure of parenting Home or lab: free or structured task	Executive function domain; Measures	Child covariate: IQ/ language
<i>Cross-sectional studies</i>								
Bibok et al. (2009)	Are parents' elaborative or directive utterances contemporarily contingent on child problem solving related to attention-switching executive function in 2-year-old children?	36	Not known	4	24	Parental Utterances; (directive or elaborative); Lab: structured task;	Executive function attention-switching (Shape Stroop, delayed alternation task, reverse categorisation tasks)	Yes
Blankson et al. (2011)	The role of home environmental stimulation & executive functioning on shyness and vocabulary in early childhood.	254	L, M, H Mixed	52	41.7	Home Environmental Stimulation composite; Toys, Activities Questionnaire (Q) &; Television, Reading, Computers at Home (Q)	Executive function composite; (Day-Night Stroop & Kaufman Assessment Battery for Children—Number recall test)	Yes
Dilworth-Bart (2012)	Does executive function mediate SES and home quality associations with academic readiness?	49	M	47	54–6	Home: Early Childhood (O, I) Home: child observed in natural, unstructured context	executive function composite; (Peg Tapping Test, Fish flanker, Stanford Binet working memory subtests)	Yes
Hopkins et al. (2013)	To what extent do contextual, parental, and child risk factors (inhibition, personality) influence depression and anxiety symptoms in preschoolers?	796	L,M,H Mixed	51	53	Parent Support & Hostility via—Parent Behaviour Inventory (Q).; Maternal scaffolding (NICHD Three Boxes Task) Home: structured tasks (3 Boxes);	Inhibitory control; (Nepsy Statue game); Also included EC measure	No
Hughes & Ensor (2005)	Are executive function and Theory of Mind related, and what effects do distal and proximal family factors have on this relationship?	129	L	39	28.44	Positive Parenting (O); (Maternal positive control e.g. praise, explanation, responsiveness, talk) Home: free play, tidy up, structured play; Laboratory: free play, tidy up, structured play (with props, puzzles, toys)	Executive function composite; (Spin the Pots, Trucks, Baby Stroop, Beads task from Stanford Binet Intelligence Scales, Detour Reaching)	Yes

Note. For type of parenting measure: Q, questionnaire; O, observation; I, interview. SES: H, high; M, middle; L, low. Race: mixed. Context of parenting measure: laboratory or home with either structured or free play.

2.3 Is Quality of Parenting Associated with Early Childhood Executive Function?

2.3.1 Parental Scaffolding and Executive Function

In five longitudinal studies, scaffolding predicted prospective development across a range of executive function domains. In research on contexts in which parents interacted with their children during a problem-solving task, higher levels of executive function in children entailing working memory and cognitive flexibility tasks were associated with greater maternal autonomy support (Bernier et al., 2010; Matte-Gagne & Bernier, 2011), verbal and physical prompting (Hammond, Müller, Carpendale, Bibok & Liebermann-Finestone, 2012), scaffolding—including praise and elaboration (Hughes & Ensor, 2009)—and maternal behaviours that maintained and redirected children’s attention (Conway & Stifter, 2012). Parental scaffolding remained significantly related to executive function when controlling for children’s language and prior executive function (Bernier et al., 2010; Hammond et al., 2012; Hughes & Ensor, 2009). Imitative learning (via maternal planning) was also associated with later executive function, albeit more modestly (Hughes & Ensor, 2009). In two cross-sectional studies in which children performed structured problem-solving tasks, parents’ elaborative utterances (Bibok, Carpendale & Müller, 2009) and a more global measure of scaffolding associated positively with cognitive flexibility at age 2 and inhibitory control at age 4 (Bibok et al., 2009; Hopkins, Lavigne, Gouze, LeBailly & Bryant, 2013).

Parent–child processes underlying parental scaffolding have been among the most broadly described putative mechanisms, and influence early executive function development more immediately or proximally than parent behaviours that are less explicitly focused on children’s learning (Hughes & Ensor, 2009; Matte-Gagne & Bernier, 2011). One study examined the relationship between the timing of parental scaffolding in the context of children’s puzzle-solving activities, finding that scaffolding predicted children’s attention-

switching executive function, even after controlling for their verbal language (Bibok et al., 2009).

2.3.2 Parental Stimulation and Executive Function

Four longitudinal and two cross-sectional studies examined associations between parental stimulation and executive function in early childhood. Parental stimulation, as indexed by the Home Observation for Measurement of the Environment (Bradley et al., 2011), has been associated prospectively with sustained growth in inhibitory control and cognitive flexibility (controlling for baseline executive function; Clark et al., 2013), increased attentional control (Mezzacappa, Buckner & Earls, 2011), and sustained attention, impulsivity, working memory and planning (Hackman, 2012). Further, in a reanalysis of data (NICHD, 2005) indicating that a combination of parental stimulation and sensitivity in infancy and early childhood predicted attention and memory performance (not planning) in the first grade, parental stimulation during early childhood (not infancy) partially mediated the adverse effects of low SES on all components of executive function at age 4.5 (Hackman, 2012). Results from cross-sectional studies of stimulation and executive function have been mixed. In one, parental stimulation (based on parents' reports) was unrelated to executive function (Blankson, O'Brien, Leerkes, Marcovitch & Calkins, 2011), while in another, an association between stimulation and executive function became insignificant after verbal ability was considered (Dilworth-Bart, 2012).

2.3.3 Parental Sensitivity (Versus Hostility) and Executive Function

Ten studies reported empirical evidence for the effects of sensitivity/hostility on executive function. In five longitudinal studies (two pairs of studies used the same dataset), executive function in early childhood was associated with maternal sensitivity (Blair, Granger et al., 2011; Hackman, 2012; NICHD, 2005; Rhoades et al., 2011). In one study, both maternal sensitivity and hostility predicted executive function (Blair, Granger et al., 2011),

while only hostility predicted executive function in another (Holochwost, 2013). In the study mentioned earlier, maternal sensitivity during early childhood related uniquely to executive function planning (not working memory, attention or impulsivity; Hackman, 2012).

Prospective executive function has also been associated with sensitivity during infancy, across diverse observational paradigms (Cuevas et al., 2014; Kraybill & Bell, 2013). In a follow-up study, parent–child attachment security predicted 3-year olds’ executive function conflict more strongly than sensitive caregiving per se (parental mentalisations, autonomy support, sensitivity; Bernier et al., 2012). Cross-sectional evidence has been mixed. One study found hostility correlated negatively with executive function (Hopkins et al., 2013), while another found positive parenting did not relate significantly to executive function once verbal ability was considered (Hughes & Ensor, 2005). To clarify the influences of parental sensitivity and hostility on early childhood executive function, researchers may have to adopt coordinated approaches to measuring parenting variables and early childhood executive function, which vary across studies.

2.3.4 Parental Behavioural Control/Discipline and Executive Function

The few studies that have examined associations between early childhood executive function and dimensions of parental control have yielded mixed conclusions. In two longitudinal studies, lower levels of parental control were related positively to child executive function two to three years later (Bindman et al., 2013; Roskam, Meunier, Stievenart & Noel, 2013). In contrast, in another study, self-reported parental disciplinary practices were unrelated to executive function (both ‘hot’ and ‘cool’ tasks; Weber, 2011). These studies did not control for IQ-related covariates and they relied largely on self-reported parenting data.

2.4 Are Associations Between Parenting and Executive Function

Moderated by Other Risk/Protective Factors?

A number of studies have tested the possibility that additional variables may moderate associations between parenting and executive function in early childhood. Among those implicated in such effects are ethnicity (Holochwost, 2013; Rhoades et al., 2011), gender (Clark et al., 2013), temperament (Blankson et al., 2011; Conway & Stifter, 2012), physiological indices of self-regulation (i.e., indices of sympathetic, parasympathetic, and cortisol stress systems; Holochwost, 2013), and pre-natal cigarette exposure (Mezzacappa et al., 2011). To illustrate, negative parenting was associated less proximally with executive function in African American children than in Caucasian children (Rhoades et al., 2011). Male gender and low social support interacted to result in lower executive function (cognitive flexibility; Clark et al., 2013). Children's temperament moderated the association between parenting and executive function (Conway & Stifter, 2012), and executive function and children's vocabulary (Blankson et al., 2011). Parental scaffolding (attention maintaining) influenced inhibited and exuberant children more strongly than low-reactive children (Conway & Stifter, 2012), while shy children exposed to high stimulation had lower executive function than their less shy peers (Blankson et al., 2011). Physiological self-regulation moderated the effects of negative intrusiveness on child executive function, but only within a subset of children characterised by a more mature physiological self-regulation (Holochwost, 2013) (Holochwost, 2013). Parental stimulation mitigated the adverse effects of cigarette exposure on child executive attention (Mezzacappa et al., 2011). These findings suggest that the developmental processes that underpin the early emergence of executive function involve complex interactions between children's characteristics and environmental inputs.

2.5 Mechanisms Through Which Parenting Operates on Executive Function

Only four studies used mediation analyses to investigate the processes through which parenting variables may produce change in executive function across early childhood. Consistent with the notion that children's language facilitates self-reflection and active control of impulsive responses (Landry & Smith, 2010), three studies suggested that the effects of parental scaffolding, sensitivity and stimulation on child executive function can be accounted for, in part, by changes in children's language capacities (Clark et al., 2013; Hammond et al., 2012; Matte-Gagne & Bernier, 2011). In one study, physical and verbal prompting predicted executive function indirectly at age 4 through verbal ability at age 3 (Hammond et al., 2012). Similarly, children's expressive vocabulary at age 2 mediated higher executive function (entailing impulse-control tasks of delayed gratification) at age 3 (Matte-Gagne & Bernier, 2011). Deficits in executive function among children whose parents did not provide a stimulating environment were accounted for, in part, by deficits in language capacity (naming colours) and processing speed (Clark et al., 2013).

Biological mechanisms involving the hypothalamic-pituitary-adrenal axis have also been implicated. Concentrations of cortisol, a glucocorticoid hormone that modulates activity in the prefrontal cortex, partially mediated the association between positive parental support and prospective executive function across the infant and toddler years (Blair, Granger et al., 2011). As such, highly supportive environments apparently result in lower levels of cortisol, which in turn account for increases in child executive function over time. This finding may support the idea that early childhood executive function develops, in part, through mechanisms that are consistent with theories of biological sensitivity (Blair, Granger et al., 2011).

In recent years, researchers have progressed considerably in investigating the contributions of parenting to the development of executive function across early childhood. Notwithstanding the inconsistencies that have at times characterised findings, studies of parenting and executive function inform developmental perspectives on self-regulation, supplementing findings from related fields, notably research into temperament (e.g., effortful control) and emotion regulation. Early caregiving influences—including parental responsiveness (Kochanska, Murray & Harlan, 2000), maternal warmth (e.g., Spinrad et al., 2007) and parental discipline (e.g., Olson et al., 2011)—have been associated with individual differences in effortful control. However, in contrast to the evidence on executive function reviewed in this chapter, research has produced discrepant findings regarding the influence of parental teaching on child effortful control (Eisenberg, Vidmar et al., 2010; Lunkenheimer, Kemp & Albrecht, 2013). A more fine-grained approach to studying the dissociable components of effortful control and executive function in relationship to parenting processes may be needed to integrate findings across these fields (Graziano, Keane & Calkins, 2010; Karreman, van Tuijl, van Aken & Dekovic, 2006).

2.6 Gaps in the Research

The findings in this review suggest four directions for research. First, researchers need to understand more fully the role of transactional parent–child dynamics in the early emergence of executive function. Individual differences in parental sensitivity are shaped, in part, by child-driven effects from attention control (Belsky, Fearon & Bell, 2007), but such evidence is limited. Research based on many levels of analysis is needed to characterise more completely such processes and their role in the complex developmental cascades in which executive function is likely to play a role across early development (see, Bornstein, Hahn & Wolke, 2013). Only three of the studies reviewed in this chapter included fathers (Bernier et al., 2012; Hopkins et al., 2013; Roskam et al., 2013); thus researchers need to examine both

maternal and paternal behaviours and risks (e.g., maternal depression; Hughes et al., 2013), particularly in light of studies indicating that each may contribute differentially to a range of children's outcomes (e.g., Yates et al., 2010).

Second, as in many other fields of developmental psychology, evidence of the influences of parenting on executive function is correlational. Demonstrating that parenting variables are associated with individual differences in executive function is different from demonstrating that change in a specific parenting variable has a causal effect. Based on studies suggesting that executive function is amenable to intervention (Bierman & Torres, *in press*; Diamond & Lee, 2011), researchers should conduct experimental tests of specific causal mechanisms through parenting interventions in the early childhood years. Such evidence may help in understanding the contributions of parenting to the distinct versus overlapping processes that underpin executive function and effortful control, and inform a unified theoretical framework to encompass both constructs (Liew, 2012; Zhou, Chen & Main, 2012).

Third, the influences of parenting on executive function do not operate equally across all children. Children's temperament, gender and ethnicity apparently moderate the influences of parenting on executive function across early childhood. Interactive effects of this kind may reflect differential susceptibility to environmental influences on executive function and warrant investigation in relationship to the predictions of emerging models in developmental psychopathology (Belsky & Pluess, 2009). The genetically informed study designs that have advanced family models of ADHD may contribute valuable evidence to models of executive function (Harold et al., 2013). Likewise, models in the field may benefit from the adoption of more domain-specific and coordinated approaches to the measurement and conceptualisation of parenting, which vary across studies (Grusec & Davidov, 2010; O'Connor, 2002).

Finally, researchers need to characterise more effectively the structure of executive function in early childhood. Consistent with existing developmental models, the studies reviewed here used paradigms focused on inhibitory control and cognitive flexibility more frequently than those focused on the working memory or planning skills that are more commonly investigated at older ages (e.g., Doan & Evans, 2011). Challenges associated with developmentally specific conceptualisation and measurement limit the potential to examine early parenting influences on a broader range of processes. As such, progress in this conceptualisation and measurement will continue to inform research into the parenting influences addressed here.

2.7 Chapter Summary

This systematic review of published and unpublished studies points to the importance of the quality of parenting in shaping the development of executive function in the formative early childhood years. The parenting behaviours most consistently associated with individual differences in executive function include scaffolding, stimulation, sensitivity and supportive discipline. While these numerous studies of low-risk families concentrate on well established domains of parenting, the individual studies in chapters 4, 5 and 6 will expand this spectrum of parenting behaviours and expressly focus on parental emotion socialisation in a high-risk sample. Furthermore, this systematic review identified that individual child (ethnicity, gender, temperament) and social factors (cigarette exposure) moderated the association between parenting and children's executive function. Thus, in the individual studies which comprise this thesis, it was important to consider an array of individual child (ethnicity, verbal language, bilingualism) and family factors (parental education and mental health) which in addition to parenting, may contribute to the emergence of preschoolers' self-regulatory capacities.

Chapter 3: Methodology

This chapter describes the methods common to the individual studies in this thesis (presented in chapters 4 to 6). Information regarding the overall project sample, recruitment processes and assessment procedures is presented here, whereas information pertaining to characteristics of the specific subsamples and specific methods employed in each respective study is provided in the individual chapters.

3.1 Participants

This thesis involved the collection of cross-sectional data by the author, who was at the time employed as an occupational therapist/family worker within a state-funded early intervention program. Participants ($N = 107$) were boys ($n = 65$) and girls ($n = 42$) aged 4 and 5 years ($M = 4.75$, $SD = 0.57$), and their mother ($n = 95$) or father ($n = 12$). The demographic characteristics of the sample and classifications related to maltreatment status are summarised in Table 3.1. This was an ethnically diverse sample, in which 36% of parents were born overseas and 19% of children spoke a language in addition to English. A total of 9 (8%) children had an Aboriginal or Torres Strait Islander cultural background. Most of the parent participants were mothers (89%), whereas fathers comprised only 11% of the parent sample. The mean age of the mothers at the time of their child's birth was 31 years, and the mean age of the fathers was 34 years. The most common family type was couple families (67%), followed by single-parent families (33%). The sample was diverse in terms of SES, as indexed by the highest level of the mothers' education. Fifty per cent of parents had university qualifications, 25% had completed tertiary college, and another 25% had only completed high school. In terms of employment, 58% of parent participants worked (full or part time) and 41% of families received some form of social welfare.

Table 3.1

Demographic Characteristics

Variable	Full sample <i>N</i> = 107
Child mean age in months	57.0 (<i>SD</i> = 6.8)
Child gender—boys/girls	65/42
Child cultural background	
Indigenous	9 (8%)
Cultural and linguistically diverse (CALD)	39 (36%)
Bilingual	20 (18%)
Father participant	12 (11%)
Mother participant	95 (89%)
Two-parent family	68 (64%)
Single-parent family	39 (36%)
Maternal mean age at child's birth	31.4 (<i>SD</i> = 6.5)
Paternal mean age at child's birth	34.2 (<i>SD</i> = 8.6)
Parents with university education	53 (50%)
At least one working parent	80 (74%)
One parent on welfare	44 (41%)

3.2 Participant Recruitment

To ensure a wide spectrum of child maltreatment risk and severity in the studies, caregiver/child participants were recruited from three different sources within Sydney and rural regions, described below. Caregivers and their children were invited to participate if they had sufficient verbal English, if their child was aged 4 or 5 years, attended preschool, and had no known developmental delay/disorder or prematurity. In addition, caregivers were required to have sufficient written English to complete questionnaires. The three main sources of recruitment were:

1. **Out-of-home care agencies.** Children in foster care ($n = 15$) were recruited from three different non-government accredited out-of-home care agencies. These children all had substantiated histories of maltreatment and had been removed from their

biological families (following statutory orders) and subsequently placed with a foster family. Managers of the out-of-home care agencies invited carers to participate if their foster child had been placed with them for 1 to 2.5 years and it was deemed to be a relatively stable care arrangement. Children in care vary considerably in terms of placement stability; hence, this criterion were set to ensure the foster parent was sufficiently familiar with the child. Four foster children resided in rural areas, while 11 lived in metropolitan regions across Sydney. Two of the 15 foster children were in a kinship care arrangement and were cared for by relatives.

2. **Brighter Futures early intervention program.** At-risk children ($n = 43$) were recruited from an early intervention program, and were all residing with their biological parent/s at the time of recruitment. This state-wide run program provided targeted support, tailored to meet the needs of vulnerable families who were expecting or had children under the age of 9. The voluntary program aimed to reduce the escalation of emerging child protection issues through providing child and family services and resources. Core services included case management, parenting programs, home visits and child care. Funded by the New South Wales government and delivered by both government and non-government agencies, the program received referrals from child protection services. Families were referred if they had at least one risk factor/vulnerability that adversely affected parenting capacity and/or the wellbeing of the children. The factor/vulnerabilities included: domestic violence; parental drug and alcohol misuse; parental mental health issues; lack of extended family or social support; parents with significant learning difficulties and/or intellectual disability; child behaviour management problems; and inadequate parenting skills/supervision.

3. **Community preschools.** A community sample ($n = 49$) was recruited comprising typically developing children who were not identified as at-risk of maltreatment by any child/family services. Children and their parents were recruited from five different preschools located within the same geographical region as the early intervention program. The authorised supervisors of the preschools invited participation from parents who, to their knowledge, had no known prior involvement with child protection services. All children in this group lived with their families and attended mainstream preschools.

3.3 Measures

3.3.1 Child Maltreatment

The Maltreatment Classification System (Barnett et al., 1993) was used to code the presence or absence of four subtypes (ranging from 0 to 4) of maltreatment experienced by children. These categories were only assigned to children from the foster care and early intervention groups who were known to child protection services. Subtypes of maltreatment included: physical abuse (non-accidental physical injury, including kicking, hitting, shaking); sexual abuse (sexual contact for adult gratification); physical neglect (failure to provide physical needs such as food and supervision); and emotional maltreatment (persistent thwarting of child's emotional needs, including children witnessing domestic violence, drug use or suicide threats). Permission to speak with their case workers was sought from caregivers recruited through the relevant foster care agencies. Caregivers from the early intervention program consented to the researcher/family worker accessing their case files. Information about family-level maltreatment or specific child protection reports recorded in the child's case files (early intervention program) or reported by the foster care case worker was used to code the child's maltreatment type/s. For example, case notes detailing unhygienic conditions, such as cat faeces and absence of bed sheets on the child's bed, were

classified as ‘neglect’. In the case of documented episodic or chronic exposure to serious domestic violence, ‘emotional maltreatment’ was coded. This coding was verified by the child’s case worker as needed. In line with prior research, the cumulative impact of multiple subtypes of child maltreatment was investigated by calculating an index reflecting the number of types of maltreatment documented for each child participant (scored 0–4) (Kim & Cicchetti, 2010). Among the foster care and early intervention participants, 73% had experienced at least one form of maltreatment. Specifically, 26% had experienced one type of maltreatment, 30% had experienced two types, and 17% had experienced three types. The most common type of maltreatment in the sample was emotional abuse (71%), then neglect (45%), followed by physical abuse (19%) and sexual abuse (2%). This co-occurrence of maltreatment types was consistent with prior research and contemporary Australian statistics on child maltreatment (AIFS, 2012; Kim & Cicchetti, 2010).

3.3.2 Parents’ Emotion-Related Socialising Behaviours

The Coping with Children’s Negative Emotions Scale (CCNES)—Short Version (Fabes, Eisenberg & Bernzweig, 1990) is a self-report instrument that reflects different ways parents respond to their young child’s negative emotions. Caregivers were presented with 11 typical situations in which young children are described as experiencing distress and negative effects (e.g., teased by peers, scared of injections). All situations involved common expressions of negative emotion for preschoolers. For each scenario, the caregiver was asked to indicate how likely (on a scale ranging from ‘very unlikely’ to ‘very likely’) he or she would be to react in each of five different ways. The five subscales within the measure’s abbreviated form were:

1. *Problem-focused*—reflecting the degree to which parents help the child solve the problem that caused the child’s distress (e.g., ‘help my child think of things to do’; $\alpha = .76$)

2. *Emotion-focused*—reflecting the degree to which parents respond with strategies designed to help the child feel better (e.g., ‘comfort him/her before and after the shot’; $\alpha = .72$)
3. *Expressive encouragement*—reflecting the degree to which parents validate and encourage the child’s expressed negative effect (e.g., ‘tell my child it’s okay to cry’; $\alpha = .73$)
4. *Punitive responses*—reflecting the degree to which parents respond with punitive, controlling responses that decrease their exposure or need to deal with the negative emotions of their child (e.g., ‘tell my child that if he starts crying then he’ll have to go to his room right away’; $\alpha = .73$)
5. *Minimisation responses*—reflecting the degree to which parents minimised the seriousness of the situation or devalued the child’s problem or emotional response (e.g., ‘tell my child that he/she is over-reacting’; $\alpha = .66$).

For the purposes of a fine-grained analysis of domain-specific parenting dimensions, scores from the individual-subscales were examined, rather than the aggregated scores that formed the positive and negative indexes (Grusec & Davidov, 2010; Spinrad et al., 2007). Evidence that the CCNES scales inter-relate in the expected directions with other theoretically derived parenting dimensions (e.g., parental anger, control) and predict measures of children’s social functioning and emotional competence supports the validity of the CCNES (Eisenberg, Spinrad et al., 2010; Fabes, Leonard, Kupanoff & Martin, 2001; Jones, Eisenberg, Fabes & MacKinnon, 2002). In previous research, the CCNES demonstrated substantial internal, test-retest reliability and construct validity. In this study, the original 7-point Likert scale was substituted for a 5-point scale, in consultation with Carlos Valiente, one of the authors of the scale. For the purpose of sensitively examining parenting quality within maltreating families, self-report measures were deemed more suited

to capture parental unsupportive responses to specific situations compared with observational methods, which are less likely to engage high-risk parents (Eisenberg et al., 1999).

3.3.3 Parental Depression

The Depression Anxiety Stress Scales 21 (DASS-21) (Lovibond & Lovibond, 1995) was used to assess parental depression. The DASS-21 is a 21-item self-report measure of depression, anxiety and stress, commonly used for research and clinical purposes. Psychometric evaluation of the measure in a representative community adult sample in the United Kingdom ($N=1,794$) showed strong internal consistency across the three scales and total scores ($\alpha = .88$ for depression, $\alpha = .82$ for anxiety, $\alpha = .90$ for stress; $\alpha = .93$ for DASS total) (Henry & Crawford, 2005). Correlations between the DASS subscales and the Beck Depression Inventory (Beck, Rush, Shaw & Emery, 1979), which ranged from .69 to .85 in clinical samples, also supports the concurrent validity of the measure (Antony, Bieling, Cox, Enns & Swinson, 1988). In this thesis, the DASS depression scale was used to assess parental depression; its internal consistency was $\alpha = .88$ in this thesis' sample.

3.3.4 Multi-Method Measures of Executive Function

Due to varying methodological and theoretical reasons, researchers have measured executive function in different ways, ranging from assessor and caregiver/teacher rating scales to performance-based measures. In this thesis, both caregiver rating scales and direct performance-based measures were used. In addition, researchers have debated whether to model executive function as one underlying construct by creating a composite score (Blair & Peters, 2003; Wiebe et al., 2008) or to model the individual components separately (Carlson, 2005). In light of this debate, in addition to composite scores, this thesis also explored the executive function measures separately, because it is possible that the relationships between environmental factors (e.g., maltreatment, contextual risk factors) may vary as a function of the specific measure being examined. For the composite score, the mean total per cent score

was calculated by dividing the sum of the per cent correct scores from all three executive function tasks by the number of executive function tasks completed by the child. For the scores on the individual performance measures, a total per cent correct score (decimal) was obtained for each measure.

Child executive function was assessed using three cognitive performance-based measures of executive function (see Appendix for protocols). These measures were age appropriate (without floor and ceiling effects), identified in previous research as valid measures of executive function, and had minimal non-executive demands (motor and verbal) (Carlson, 2005; Garon et al., 2008). In addition, these measures (excluding the Happy–Sad Stroop Task but including the Day–Night Stroop) have been shown to be highly correlated with each other by loading on the same inhibitory control or ‘conflict’ factor, after controlling for age, gender and verbal ability (Carlson & Moses, 2001; Diamond, Carlson & Beck, 2005). In line with prior study designs that have tested for individual differences in executive function, tasks were administered in a fixed order so that possible fatigue or transfer effects would be consistent across participants (Carlson & Wang, 2007). Child executive function scores from the three executive function measures were first correlated to examine the appropriateness of a composite score. All intercorrelations were significant, ranging from $r = .28 - .32$ at $p < .001$; however, internal consistency was not acceptable (Cronbach’s $\alpha < .05$), which may have been due to the small number of measures. However, based on prior intercorrelatory evidence, a composite executive function score based on the average of these three measures was calculated for subsequent analyses (Carlson & Moses, 2001, McAlister and Petersen, 2013).

The Happy–Sad Stroop Task (Lagattuta, Sayfan & Monsour, 2011) is a recently developed measure of inhibitory control and working memory that is a variant of the commonly used Day–Night Stroop-like executive function measure (Gerstadt, Hong &

Diamond, 1994). However, unlike the Day–Night measure, the Happy–Sad version has no floor or ceiling effects and is sensitive across a wide age spectrum, from age 4 to adulthood (Gerstadt et al., 1994; Lagattuta et al., 2011). This task assesses children’s ability to inhibit a natural tendency to give a verbal prepotent or dominant response while remembering the rule for the correct response. In the task, children are initially instructed to say ‘happy’ to happy face cards and ‘sad’ to sad face cards in two teaching trials. Following this, children are introduced to the changed rules of the ‘silly game’: ‘When you see a sad face, we call it “happy”; when you see a happy face, we call it “sad”’. Children were shown 16 cards presented one at a time in a fixed counterbalanced order, and were scored for correct responses (maximum correct was 16). Only the child’s first response was scored, regardless of whether they had later given a self-corrected answer. This measure has been shown to demonstrate good construct validity, test-retest reliability and adequate variability in 4–11-year-old children and adults (Lagattuta et al., 2011).

The Tapping Test (Diamond & Taylor, 1996) is a measure of inhibitory control and working memory. This measure is used to assess children’s ability to inhibit a natural tendency to mimic the examiner’s action, while remembering the rule for the correct action. The child is instructed to tap a wooden dowel twice when the researcher taps once, and to tap once when the researcher taps twice. After practice trials, children are administered 16 trials in which eight of each action (one tap and two tap) are given in a counterbalanced sequence. Performance of the Tapping Test was measured on a scale from 0 to 16 by the number of correct taps recorded during the task. This task is similar to the Happy–Sad Stroop Task in that both require the ability to keep two rules in mind and to inhibit a natural response; however, the Tapping Test requires a motor response whereas the Happy–Sad Stroop Task demands a verbal response, which has been shown to be more taxing for young children (Anderson & Reidy, 2012). The Tapping Test is an age-appropriate executive function task

for young children and has been empirically linked with prefrontal cortex function (Gerstadt et al., 1994). It has proven validity for measuring executive function in young children who have limitations with respect to language processing. In a recent study of 4–5 year olds, the internal consistency of the Tapping Test was satisfactory, with a Kuder-Richardson (KR-20) coefficient of .88 (Rhoades, Greenberg & Domitrovich, 2009).

The Dimensional Change Card Sort (DCCS) (Zelazo, 2006) measures children's attentional/cognitive flexibility, rule use, inhibitory control and working memory (Diamond et al., 2005; Zelazo, Frye & Rapus, 1996). The child is required to sort a series of six cards (e.g., red truck, blue star) into separate piles, first according to colour—the pre-switch phase. After completing six trials, the child sorts the same cards according to shape—the post-switch phase. Only the post-switch phase is scored, with one point credited for every card sorted correctly, with five or more representing a pass. The standard version provides a widely used index of executive function for preschoolers and has been found to discriminate children with ADHD and autism (Zelazo, 2006). Children's performance of the DCCS improves with age and correlates positively with other measures of executive function (Carlson, 2005). Post-switch scores in this thesis ranged from 0 to 6 ($M = 4.9$; $SD = 1.9$).

The Behaviour Rating Inventory of Executive Function (BRIEF-P) (Gioia, Espy & Isquith, 2003) is a standardised parent or teacher rating scale for assessing behavioural manifestations of executive function in preschoolers (2–5 years) in naturalistic environments such as the home or preschool. Caregivers are asked to rate the frequency of their child's problem behaviour in the preceding six months using a three-point scale (never, sometimes, and often) for each of the 63 items, across the five clinical scales. The five clinical scales include: Inhibit (16 items related to impulse control), Shift (10 items related to ability to shift from one activity to another or flexible problem solving), Emotional Control (10 items related to the ability to modulate emotional responses), Working Memory (17 items related to

holding information in mind for the purposes of completing a task), Plan/Organise (10 items related to setting goals and developing steps ahead of time to complete tasks). The clinical scales combine to form three indexes: Inhibitory Self-Control (Inhibit and Emotional Control scales), Flexibility (Shift and Emotional Control scales) and Emergent Metacognition (Working Memory and Plan/Organise), and one summary composite, the Global Executive Composite (five clinical scales).

As the three indexes are not completely independent due to the inclusion of the Emotional Control scale in two indexes, it was decided to use the five individual clinical scales for this thesis (Sherman & Brooks, 2010). Each item was scored on a 3-point scale (1 = never, 2 = sometimes, and 3 = often). *T* scores were generated by age and gender, based on national norms. Higher *T* scores indicate lower levels of self-regulation, and a *T* score of 65 represents 1.5 standard deviations above the mean, and distinguishes non-clinical scores from clinical scores. The measure has demonstrated psychometric reliability and validity and has been correlated with established measures of child behaviour and ADHD (Espy et al., 2011; Gioia et al., 2003). Increasing evidence suggests the BRIEF-P may be useful for analysing profile scores specific to different clinical groups (e.g., language disorders) (Wittke, Spaulding & Schechtman, 2013). Importantly, the BRIEF-P has been used as a valid caregiver report of executive function in maltreated children (Merz & McCall, 2011). In this thesis, internal consistency of all five BRIEF-P scales was high ($\alpha = .84$ for Shift, $\alpha = .86$ for Emotional Control, $\alpha = .90$ for Working Memory, and $\alpha = .82$ for Plan/Organise).

3.3.5 Child Verbal Language

The Peabody Picture Vocabulary Test (PPVT-III; Dunn & Dunn, 1997) is a screening measure of verbal ability, suitable for children and adults aged from 2.5 to 90 years (see Appendix). To control for children's general language skills in this thesis, verbal language was captured by this measure. The PPVT-III has been endorsed as a screening measure of

intelligence and achievement, and found to correlate with various measures of intelligence and achievement, including the Full Scale IQ of the Wechsler Intelligence Test for Children. In the test, a child is presented with four pictures at a time and asked to point to a picture that best represents the word spoken by the examiner. The child proceeds to identify pictures until a ceiling of eight errors is reached within the highest set of items administered. The PPVT-III yields standard scores (i.e., $M = 100$; $SD = 15$), takes 15 minutes to complete and demonstrates sound reliability and validity across age groups. Standard scores were used for this thesis.

3.4 Procedure

Ethical approval to conduct the study was gained from the researcher's university, the Benevolent Society Research Advisory Committee and the New South Wales Department of Community Services. Each child and his/her parent/caregiver attended a single, 40-minute session at the preschool or early intervention centre. Foster care children were visited at their homes by the researcher in order to reduce the travel burden for families who lived across a broad geographical region. At the commencement of the session, the parent/caregiver first signed informed consent and permission for their child's participation, according to approved ethical procedures. The child was seated at a child-sized chair and table, opposite the researcher, and adjacent to his/her parent. Where possible, the assessment was conducted in a quiet section or room within the child's preschool (or home for foster children).

The researcher administered the three performance measures of executive function to the child, while the caregiver observed and completed the parent questionnaire. The executive function measures were presented in a fixed order, which is standard practice in individual differences research (Carlson & Moses, 2001). This was so all children were exposed to identical stimuli and possible performance consequences (e.g., fatigue during the final task). For each of the three tasks, the materials (picture cards or wooden dowel) were placed

between the child and the researcher, approximately 20 cm from the child. The child was provided with teaching and trial exercises before actual scoring commenced. When necessary, the researcher provided verbal encouragement and prompting to assist the child's focus.

Following completion of the executive function tasks, the child was administered the PPVT-III. Due to the scoring requirements of this measure, children have to continue on this task until a minimum number of errors are reached. Consequently, some children who performed well had to continue for as long as 20 minutes before stopping. The researcher provided verbal encouragement and prompting when appropriate.

Caregivers observed their child's executive function performance while completing the questionnaire package, which contained the following: brief demographic questionnaire (see Appendix), BRIEF-P or caregiver rating scale of executive function, mental health scale (DASS) and parenting measure (CCNES). At the conclusion of the session, the child was given a set of stickers as a reward and the caregiver was thanked for their participation. Following the session, the researcher collated and scored all child measures and caregiver questionnaires. Every caregiver was mailed an individual feedback report that provided a brief interpretation of their child's performance and standardised questionnaires (e.g., DASS and BRIEF-P).

3.5 Chapter Summary

This chapter has shown the common methods used across the following three studies in the thesis. As highlighted in the earlier chapters it was important to examine parenting dimensions beyond the broad common ones of sensitivity, scaffolding and stimulation that had been studied in prior studies of executive function. Thus, the measure of ERSB's (CCNES) was selected to provide a much needed examination of the link between parents' emotion socialisation behaviours and child executive function. In line with the ecological-

transactional model, multiple child (e.g., verbal language, ethnicity) and family variables (e.g., parental depression) were assessed as they have been found to account for environmentally driven individual differences in early development. Based on prior research, it was important to code the specific type of maltreatment that children experienced to capture more nuanced effects on executive function. Finally, the methods included both performance-based and caregiver rating scales of executive function to provide a broader perspective of this construct, as justified in the following chapter.

Chapter 4: Study 1—Relationship Between Caregiver Rating Scales and Performance Measures of Executive Function in Maltreated Preschoolers

In light of the developmental significance of executive function, it is important to identify executive function problems prior to children's entry into school, to enable the provision of early intervention and prevent the development of psychopathology (Anderson & Reidy, 2012; Schoemaker, Mulder, Deković & Matthys, 2013). Evaluation of child executive function is more commonly undertaken for school-age children with medical or neurological conditions (e.g., traumatic brain injury, ADHD); however, there is an increasing yet unmet demand for evaluation of executive function in other at-risk populations, including younger children exposed to psychosocial risk factors such as maltreatment (Anderson, 2002). One barrier to the evaluation of executive function in different populations of young children is the limited availability of valid, age-appropriate measures (Willoughby et al., 2013). Secondary to this problem, is the uncertainty regarding the degree to which different evaluation approaches measure the same construct of executive function (Anderson & Reidy, 2012). This chapter presents a study which investigates the relationship between performance-based measures of executive function tasks delivered in a clinic (Carlson, 2005) and caregiver rating scales of children's observed executive function in naturalistic settings (Isquith et al., 2005). Psychometric support for both forms of measurement have grown considerably in recent years; however, the relationship between caregiver rating scales and performance-based measures of executive function has rarely been tested in children aged between 3 to 6 years (Willoughby, 2013). Moreover, no multi-method study of executive function has been conducted on maltreated children in this age group.

4.1 Construct of Executive Function

The precise factor structure of executive function in the early childhood period (3–6 years) is hotly debated. Although substantial evidence indicates that executive function in early childhood may be best conceptualised as a single ‘unitary’ construct of executive function (undifferentiated subcomponents) (Bull, Espy, Wiebe, Sheffield & Nelson, 2011; Willoughby et al., 2013), contrary evidence provides support for a ‘diversity’ structure (distinct but correlated dimensions) (Miyake et al., 2000; Shing, Lindenberger, Diamond, Li & Davidson, 2010). Further, researchers argue that executive function may be delineated according to ‘hot’ motivational/emotional aspects or by ‘cool’ cognitive aspects. The conventional performance-based measures of executive function that comprise non-affective or neutral tasks (e.g., sorting by shape or colour) tend to tap ‘cool’ aspects of executive function (Zelazo & Carlson, 2012).

These conceptual issues, coupled with the variable developmental trajectories of executive function components in young children, pose challenges for the clinical assessment of early childhood executive function (e.g., Diamond, 2013; Garon et al., 2008). Further, executive function measures are susceptible to ‘task impurity’, in that no single measure purely assesses domain-general executive function abilities without the influence of domain-specific elements of cognition (e.g., memory, language, visual-spatial perception) (Anderson & Reidy, 2012). Researchers have recommended that this problem of ‘task impurity’ is minimised when clinicians use a variety of qualitative, quantitative or cognitive-process methodologies to enhance precision in assessment (Anderson & Reidy, 2012). In addition, executive function difficulties manifest in a wide range of behaviours that are difficult to capture with any single measure of executive function (Anderson, Anderson, Northam, Jacobs & Mikiewicz, 2002). For example, some maltreated children present with cognitive problems in following and recalling instructions or flexibly changing tasks (Lewis-Morrarty

et al., 2012), while other children are observed to have problems with impulsivity, inattention or self-regulation (Pears, Fisher, Bruce, Kim & Yoerger, 2010). There has been increasing research that has attempted to characterise patterns or profiles of executive function scores in children with specific disorders (e.g., ADHD) (McCandless & O’Laughlin, 2007). However, to date, there has been little research contributing data for describing profiles of executive function scores characteristic of maltreated preschoolers. Thus, it is important to clarify current approaches to executive function evaluation for this population.

4.1.1 Performance-Based Measures of Executive Function

Executive function has been traditionally assessed using standardised, neuropsychological performance measures involving novel, problem-solving tasks administered under highly structured and replicable conditions (Anderson & Reidy, 2012; Pennington & Ozonoff, 1996). The most widely used tests are developed by researchers and assess behaviours that infer specific executive function processes, including inhibitory control (e.g., Stroop tasks), working memory (e.g., Spatial Working Memory), cognitive flexibility (e.g., DCCS) or planning (e.g., Tower of London) (for a review, see Anderson & Reidy, 2012; Carlson, 2005). Most tests are scored based on accuracy and/or response time. These tests have also been adapted for tablet or computer platforms, which ensure standardisation of administration, detailed recording of scores and enhanced appeal for young children (Anderson & Reidy, 2012). Other performance measures include individual subtests of well-established general cognitive assessments or neuropsychological assessment batteries (e.g., NEPSY-II, Korkman, Kirk & Kemp, 2007), some of which are appropriate for preschoolers. Many performance-based measures demonstrate age-related trends and are sensitive to individual differences, diagnostic groups, intervention effects and neural correlates (e.g., brain structural changes) (e.g., Diamond, 2013; Diamond et al., 2007; Shallice et al., 2002). Other advantages of performance-based executive function measures

include their objectivity (no reporter bias) and suitability for young children who have limited memory, language or motor skills.

One frequently discussed limitation of performance measures relates to the ecological validity, in that they have limited functional and predictive relationships to naturally occurring executive function behaviours in everyday contexts (Anderson & Reidy, 2012). It has been argued that the nature of the artificial test conditions, including the high degree of structure, minimal distractions and the examiner's prompting or encouragement, are not characteristic of real-life settings. Performance measures are delivered in a way that optimise children's performance (e.g., through prompting or structure) and have been thought to capture the efficiency of goal pursuit (Toplak et al., 2013). Designed with high internal validity, many performance measures assess contextually constrained executive function abilities rather than broad levels of adaptive function (Isquith, Roth & Gioia, 2013). In addition, few performance measures have undergone formal psychometric testing, provide normative data or are suitable for wide age ranges (for exceptions, see Korkman et al., 2007; Weintraub et al., 2013).

4.1.2 Caregiver/Teacher Rating Scales of Executive Function

Caregiver/teacher rating scales of executive function were developed to provide an ecologically valid indicator of child executive function behaviours in routine problem-solving tasks in school or home contexts (Anderson & Reidy, 2012). Rating scales provide information on child executive function abilities beyond the clinic setting and across a range of naturalistic settings (Sherman & Brooks, 2010). Executive function rating scales are thought to capture integrated, qualitative and behavioural components of executive function, whereas performance measures are thought to capture underlying, specific cognitive components (Anderson et al., 2002; McAuley, Chen, Goos, Schachar & Crosbie, 2010). Some researchers emphasise that executive function rating scales assess performance in

unconstrained situations where no explicit instructions to maximise performance are provided. Caregiver or teacher executive function rating scales such as the BRIEF-P (Gioia et al., 2003) provide norm-based scores for clinical decision making and are suitable for assessing large numbers of children. The main disadvantage of executive function rating scales is their susceptibility to reporter bias, due to factors such as the informant's linguistic abilities, emotional relationship with the child, or knowledge and expectations of child development (Denckla, 2002; Isquith et al., 2005). Further, only a few, validated rating measures are currently suitable for young children (Isquith, Gioia & Espy, 2004; Thorell & Nyberg, 2008). Despite these methodological and conceptual distinctions between rating scales and performance-based executive function measures, both are assumed to measure the same general construct. However, in light of available studies that have empirically tested the relationship between these measures (McAuley et al., 2010; Toplak et al., 2013), this study will further clarify whether high levels of executive function competence measured by caregiver ratings is associated with high scores on performance-based measures.

4.1.3 Relationships Between Caregiver Rating Scales and Performance-Based Measures of Executive Function

The results of studies that have examined the relationship between caregiver rating scales and performance-based measures of executive function in children have often been mixed. In a recent review of 20 studies (13 involving children), an overall weak median correlation ($r = .19, p < .05$) between various executive function rating and performance measures was found. Specifically, only 24% of the total 286 correlations were found to be statistically significant (Toplak et al., 2013). Of the 13 studies (8 involving school-aged children) that compared scores on the BRIEF (school-aged version of BRIEF-P) with executive function performance measures, the overall median correlation between them was even weaker ($r = .15, p < .05$) (Toplak et al., 2013). The authors explained the discrepancy in

scores by suggesting that performance measures assess efficient goal pursuit (or algorithmic minds), whereas ratings scales assess rational goal pursuit (reflective minds).

McAuley et al. (2010), who examined similar associations between measures, found that comprehensive batteries of executive function performance measures were more likely to be correlated with executive function rating scales than singular measures of executive function, possibly due to the increased specificity or sensitivity of multiple measures. Other researchers have proposed that discrepancies between scores may arise from sample characteristics such as children's clinical status or executive function impairment (Denckla, 2002; McAuley et al., 2010). Most of the studies reviewed in Toplak et al. (2013) involved school-aged children or youth with medical or neurological conditions (e.g., traumatic brain injury, epilepsy). According to Denckla (2002) and Silver (2000), children with neurological conditions or prefrontal impairments (e.g., traumatic head injury) tend to perform relatively well in the artificially structured environment of a cognitive executive function assessment, in comparison to their poor performance of executive function tasks in everyday routine tasks. These researchers argued that performance measures of executive function may be less sensitive than rating scales in identifying executive function problems in children with higher levels of impairment. Thus, in the review by Toplak et al. (2013), the samples' bias towards older children with complex executive function impairments may have accounted for the limited association between the two measurement approaches. Consequently, this research which compares executive function measures among younger children with less serious neurological impairments is warranted.

It has also been suggested that environmental factors such as SES or family functioning may have a greater influence on child executive function behaviours when they are observed in the home or school compared with their assessment in a clinic (McAuley et al., 2010; Silver, 2000). These environmental factors may then account for the differences

between the two approaches to executive function measurement. As executive function development has been shown to be consistently associated with SES (Sarsour et al., 2011), it follows that child executive function behaviours in ‘less controlled’ everyday environments (e.g., ‘has trouble finishing tasks’) may be more strongly influenced by SES than executive function abilities captured in ‘more controlled’ performance-based measures. Though researchers have proposed that environmental variables potentially moderate the association between rating scales and performance measures of executive function (McAuley et al., 2010; Silver, 2000), few studies have tested this. One study examined whether the association between rating scales and performance-based measures of executive function varied according to SES, indexed by group membership in the Head Start program, a comprehensive program for low-income children and their families (Duncan, 2012). The findings were positive: performance measures (Day-Night Stroop, DCCS, Head-Toes-Knees-Shoulders) were correlated with teachers’ rating scales of executive function (specifically, inhibitory control and attention) only in the children belonging to the comparison group, and not in the low-income children from the Head Start group (Duncan, 2012). As this study employed teacher rating scales and not caregiver ratings, it remains unclear whether environmental variables would moderate the association between children’s caregiver rating scales and performance measures of executive function in additional populations of at-risk children.

In contrast, other studies of preschoolers suggest a limited association between caregiver rating scales and performance measures of executive function. Two small studies ($n < 60$) conducted on typically developing children and preschoolers with ADHD, respectively, found no correlation between caregiver ratings of executive function in the BRIEF-P and a battery of performance-based measures of executive function (Liebermann, Giesbrecht & Muller, 2007; Mahone & Hoffman, 2007). Nonetheless, the findings of the former study cannot be generalised to non-ADHD children (Bodnar, Prahme, Cutting, Denckla & Mahone,

2007), and the latter study was limited by the use of only four of the five executive function rating scales of the BRIEF-P (Liebermann et al., 2007). Another study of preschoolers that primarily examined executive function correlates of problem behaviour found a number of significant zero-order correlations between caregiver rating scales and performance measures of executive function (Espy et al., 2011). Because the assessment of executive function was not the primary purpose of this study, the findings provide limited insights into the specific relationship between rating and performance measures of executive function in young children.

Together, the limited findings suggest inconsistent evidence of a strong relationship between caregiver rating scales and direct assessments of executive function. Further research will help determine whether the two approaches are measuring different constructs and the subsequent clinical utility of using one or both measures for the assessment of pre-schoolers (Willoughby, 2013). Therefore, this thesis' specific examination of the relationship between these two types of measures of executive function in the context of clinical assessments with maltreated preschoolers will help inform assessment protocols for this at-risk population.

4.2 Study 1

For children at risk of maltreatment, the early measurement of executive function is important for the provision of early intervention supports and the prevention of maladaptive outcomes. Currently, it remains unclear to what extent caregiver rating scales and performance-based measures of executive function are related and whether they assess the same general construct in maltreated preschoolers. As discussed, prior research, which has predominantly been conducted with brain-injured children, has found limited significant correlations between these measures. Findings from the few studies conducted on preschoolers found mixed results and only one study considered environmental variables as a possible moderator of the association between measures. In an attempt to address these

research gaps, Study 1 was the first to examine the association between caregiver rating scales and performance measures of executive function in a sample of maltreated and non-maltreated preschoolers. In addition, Study 1 sought to understand the nature of the relationship between these measures by testing whether the association between measures would be more or less in children with higher or lower levels of maltreatment.

The central aim of this study was to examine the nature and the strength of the association between children's scores on a caregiver rating scale and three performance measures of executive function within a sample of maltreated and non-maltreated children. The first step was to describe the profile of executive function scores in maltreated children relative to non-maltreated children. Following this, two fundamental hypotheses were explored. First, it was hypothesised that caregiver ratings of executive function would be associated with performance-based measures of executive function. Although correlations between measures were shown to be inconsistent and only modestly significant in studies of older brain-injured children (Toplak et al., 2013), it was anticipated that the measures would be consistently correlated in the current sample of preschoolers who had no medical or neurological conditions. Second, it was hypothesised that the association between the two measurement approaches would be moderated by the environmental factor of maltreatment risk, such that the association would be stronger with absent or lower levels of maltreatment. This was expected based on theoretical and empirical evidence that environmental risk factors such as Head Start status moderate (weaken) the association between rating and performance measures (Duncan, 2012; Silver, 2000).

4.3 Method

4.3.1.1 Participants

Participants ($N = 107$) were preschool boys ($n = 65$) and girls ($n = 42$) aged 4 and 5 years ($M = 4.75$, $SD = 0.57$), and their mother ($n = 95$) or father ($n = 12$). The demographic

characteristics and maltreatment classifications of the 107 parent-child dyads are summarised in Table 3.1. This was an ethnically and economically diverse sample: 36% of parents were born overseas and 19% of children spoke a foreign language in addition to English. A total of nine children were Aboriginal and Torres Strait Islander. Only 12 fathers participated, meaning 89% of respondents were mothers (mean age 31 years at birth of child). Half the parents in the sample had obtained university qualifications, 40% of families received social welfare and 34% were single-parent families. Most of the children scored within normal limits (standard score 85–115) in the PPVT-III, with a mode score of 97 and mean of 107.

4.3.1.2 Measures

For Study 1's analysis, child executive function performance was assessed with both caregiver ratings using the BRIEF-P (Gioia et al., 2003) and three performance-based measures (Happy–Sad Stroop Task, Tapping Test and DCCS) described in section 3.3. The method for assessing child verbal language (PPVT-III), which was a covariate in this analysis, is also described in section 3.3.

4.3.1.3 Procedures

Ethics approval for this study was obtained from the University's Research Ethics Committee. Parents/caregivers were provided with information about the research in the session, prior to providing written consent. Each child, accompanied by their parent/caregiver, attended a single 40-minute session at the preschool, early intervention centre or family home (foster care families). The children were administered three performance-based executive function measures followed by a verbal language test. Caregivers completed a brief demographic questionnaire and a standardised caregiver rating scale of executive function (BRIEF-P). Following the session, the children were rewarded with decorative stickers, and caregivers received a written report in the mail, which provided feedback on the child's executive function (rating measure) and verbal language scores.

4.4 Results

4.4.1.1 Descriptive Statistics

Descriptive statistics and bivariate correlations among all key variables and their relationship to child age (in months), child verbal language (indexed by PPVT-III) and maternal education are provided in Table 4.1. In line with the reported high and significant intercorrelations among BRIEF-P scales in the original standardisation study, Study 1 found significant medium to high intercorrelations among the BRIEF-P scales, ranging from $r = .34, p < .01$ (Shift and Inhibit) to high $r = .82, p < .01$ (Working Memory and Plan/Organise) (Sherman & Brooks, 2010). Child age was significantly correlated ($p < .05$) with three of the BRIEF-P scales (raw scores on Inhibit, Shift, Working Memory) and two of the three direct measures of the Happy–Sad Stroop Task and Tapping Test ($p < .01$). The direction of the coefficients indicated that higher age was associated with higher executive function ratings and performance measures. Child verbal language was only weakly correlated with BRIEF-P Working Memory ($r = -.23, p < .05$), and maternal highest education was only weakly correlated with BRIEF-P Plan/Organise ($r = -.26, p < .01$), both in the expected directions (better verbal language and SES were associated with higher executive function). Due to these findings, child language and maternal highest education were not included as covariates in the main analyses, along with child gender, which was not found to be related to executive function variables. Child ethnicity (indigenous/non-indigenous status) was correlated with executive function variables and was included as a covariate in the main analyses. As expected, the Happy–Sad Stroop Task was significantly correlated with the two other direct tests: Tapping Test ($r = -.28, p < .01$) and DCCS ($r = .32, p < .01$). The latter correlated only with the Happy–Sad Stroop Task.

Table 4.1

Correlations Among Study Variables and Measures of Executive Function

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
1. BRIEF-P Inhibit	--1												
2. BRIEF-P Shift	.34**	--1											
3. BRIEF-P Emotional Control	.71**	.50**	--1										
4. BRIEF-P Working Memory	.67**	.42**	.49**	--1									
5. BRIEF-P Plan/Organise	.67**	.37**	.51**	.82**	--1								
6. Happy–Sad Stroop Task	-.16	.40	-.07	-.24*	.23*	--1							
7. Tapping Test	-.20*	-.40	-.13	-.34**	-.25*	.28**	--1						
8. DCCS	-.17	-.10	-.05	-.07	-.05	.32**	.18	--1					
9. Child age	-.19*	-.20*	-0.10	-.21*	-.12	-.26**	.34**	.09	--1				
10. Child verbal language (PPVT)	.02	-.12	.13	-.23*	-.18	.04	.14	.04	.00	--1			
11. Maternal education	-.09	.05	-.14	-.16	-.26**	.16	.11	.15	.00	.12	1		
12. Maltreatment (count)	.40**	.12	.35**	.33**	.38**	-.28**	-.39**	-.17	-.11	-.06	-.12	1	
13. Child ethnicity	.08	-.08	-.01	.22*	.24*	-.16	-.31**	.27**	-.15	-.07	-.31**	.21	1
<i>M</i>	27.72	15.55	16.98	26.71	16.65	.81	.77	4.93	57.0	107.50	12.90	.74	1.08
<i>SD</i>	6.95	4.10	4.14	6.60	4.09	.13	.22	1.95	6.84	13.67	1.56	1.04	.28

Note. DCCS = Dimensional Change Card Sort. Means are based on raw scores, except for PPVT (standard score)

* $p < .05$; ** $p < .01$

4.5 Data Analytic Plan

First, descriptive statistics (means, frequencies) were used to examine general levels of BRIEF-P *T* scores within the maltreated and non-maltreated groups. Children recruited from the foster care and early intervention program who were determined to have experienced at least one type of maltreatment (based on the Maltreatment Classification System) were classified into the maltreated group ($n = 42$). The remainder of participants were classified into the non-maltreated group ($n = 65$). For each group, descriptive statistics of the executive function scores were used to create an executive function profile for the maltreated children group, relative to the non-maltreated group. These groups did not differ according to child age or gender. Second, bivariate correlations were analysed to explore the relationship between performance-based and caregiver rating measures of executive function (BRIEF-P clinical scale raw scores). Third, linear regression was used to examine the moderation of maltreatment risk on the relationship between rating scales and performance measures of executive function. Separate analyses were conducted for each of the three dependent variables of the Happy-Sad Stroop Task, Tapping Test and DCCS. Independent variables (five BRIEF-P scales of Inhibit, Shift, emotional Control, Working memory, Plan/Organise) were tested in five separate models (to reduce collinearity). This resulted in a total of 15 separate regression analyses. For each model the variables of child age, ethnicity, main effects of maltreatment risk and each BRIEF-P scale were entered. Then the product terms: Maltreatment $\times$ each BRIEF-P scale were entered to test interaction effects. Significant interaction effects were examined by testing whether the slopes of the regression lines at low or high values of maltreatment differed significantly from zero.

As recommended for testing interaction terms in regressions, all predictor variables were first centred (Aiken & West, 1991). The Variance Inflation Factor (VIF) (Velleman, 1981) was used to ensure no violation of multicollinearity. Significant interaction terms were

probed post-hoc using the established method of simple slope analysis, outlined by Aiken and West (1991), which is recommended for interpreting moderating effects in child and family research (Holmbeck, 2002). Using this method, conditional moderator variables (corresponding to +1 *SD* from the centred value for each participant) were computed to test the significance of the respective independent variables at high and low levels of the moderator variable (maltreatment risk).

4.6 Profile of BRIEF-P Ratings Within Maltreated and Non-maltreated Groups

Descriptive statistics were used to obtain mean *T* scores on the BRIEF-P clinical scales (Inhibit, Shift, Emotional Control, Working Memory, Plan/Organise) and indexes (Inhibitory Self-Control Index, Flexibility Index, Emergent Metacognition Index, Global Executive Composite) for both maltreated and non-maltreated groups, as presented in Figure 4.1. According to the standardisation manual of the BRIEF-P, higher *T* scores indicate greater degrees of executive function problems and *T* scores (scales and indexes) at or above 65 (1.5 *SD*) are clinically significant. The data in this figure illustrate that the profile of mean *T* scores for the maltreated group was more elevated with greater fluctuations among the scales and indices than the non-maltreated group. The most elevated scale in the maltreated group was the Inhibit scale, whereas for the non-maltreated group it was Working Memory. The profile illustrates that not all maltreated children will necessarily manifest clinically significant scores. Percentages of clinically significant *T* scores for the maltreated and non-maltreated groups are presented in Table 4.2. The maltreated group had higher percentages of clinically significant *T* scores for the BRIEF-P indexes relative to the non-maltreated group.

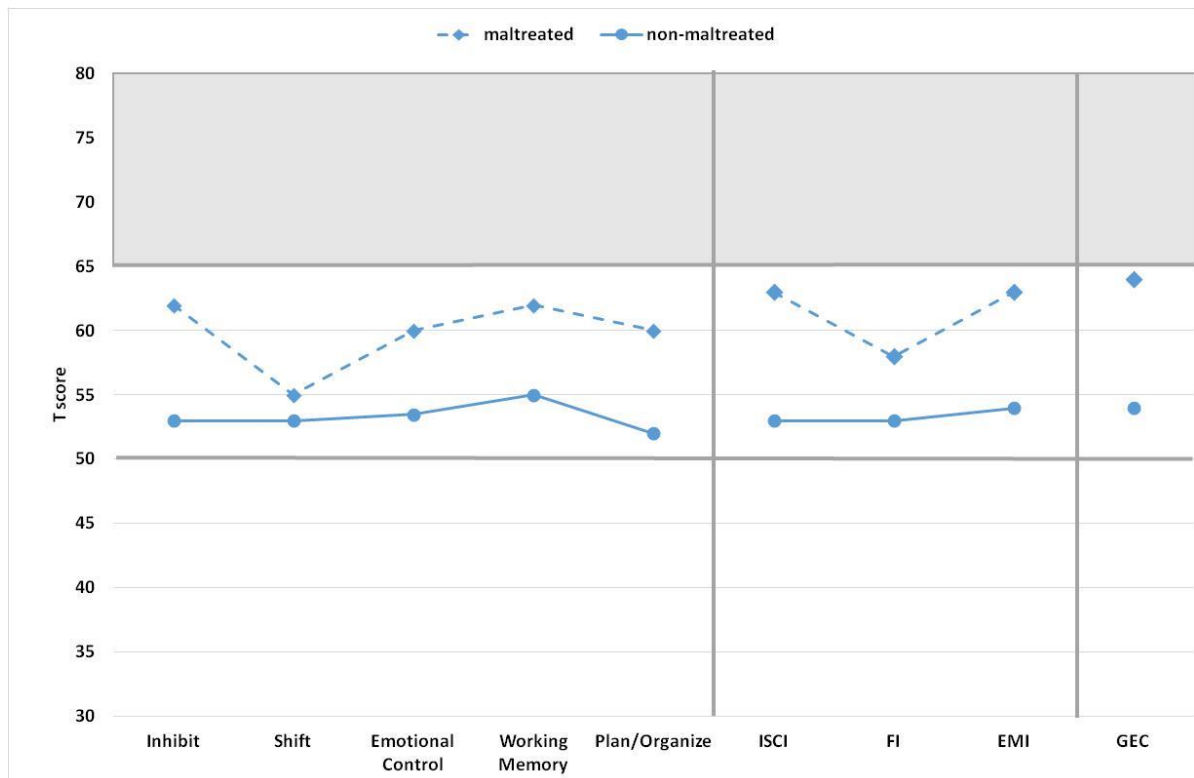


Figure 4.1. Profile of BRIEF-P scale/index scores for maltreated and non-maltreated groups

Note. ISCI = Inhibitory Self-Control Index. FI = Flexibility Index. EMI = Emergent Metacognition Index. GEC = Global Executive Composite. Mean T score = 50. $SD = 10$. T scores ≥ 65 indicate clinically significant scores.

Table 4.2

Percentage of Clinically Significant BRIEF-P Index Scores Across Groups

BRIEF-P Clinical Index	Group	
	Non-maltreated ($n = 65$)	Maltreated ($n = 42$)
Inhibitory Self-Control Index	17	45
Flexibility Index	17	31
Emergent Metacognition Index	19	48
Global Executive Composite	21	52

Note. BRIEF-P index T scores ≥ 65 are considered clinically significant.

4.6.1.1 Hypothesis 1: Association Between Caregiver Ratings and Performance Measures of Executive Function

Bivariate correlations were computed to assess the relationship between BRIEF-P scales and direct measures for the entire sample and are listed in Table 4.3. Of a total of 15 correlations, five were significant, with an overall significant mean correlation ($r = .14$, $p <$

.05. The correlation coefficients (r s) between behavioural and cognitive parameters varied from .00 to .34. As would be expected, the Happy–Sad Stroop Task, which taps a child’s working memory for their ability to hold two rules in mind while inhibiting a prepotent response, correlated primarily with the BRIEF-P scales of Working Memory and Plan/Organise ($r = -.24, p < .05$ and $r = -.23, p < .05$, respectively). The negative direction of the coefficient indicates that higher scores on the Happy–Sad Stroop Task were associated with lower scores (better ability) on Working Memory and Plan/Organise ability. The Tapping Test, which involves both inhibitory control and working memory, was significantly correlated with BRIEF-P scales of Inhibit ($r = -.20, p < .05$), Working Memory ($r = -.34, p < .01$) and Plan/Organise ($r = -.25, p < .05$). The DCCS, which requires inhibitory control and attentional/cognitive flexibility, was negatively correlated with the BRIEF-P Inhibit scale but did not reach statistical significance ($r = -.17, p < .07$).

Table 4.3

Correlations Between Caregiver Rating Scales and Performance Measures of Executive Function

BRIEF-P scales	Happy–Sad Stroop Task	Tapping Test	DCCS
BRIEF-P Inhibit	-.16	-.20*	-.17
BRIEF-P Shift	.40	-.40	-.01
BRIEF-P Emotional Control	-.07	-.13	-.05
BRIEF-P Working Memory	-.24*	-.34**	-.07
BRIEF-P Plan/Organise	-.23*	-.25*	-.05

Note. DCCS = Dimensional Change Card Sort. * $p < .05$; ** $p < .01$.

4.6.1.2 Hypothesis 2: Maltreatment Moderates the Association Between Caregiver Rating Scales and Performance Measures of Executive Function

As presented in Table 4.4, linear regression was used to test the theoretically derived hypothesis that the environmental factor of maltreatment risk would moderate associations between caregiver rating scales and performance-based measures of executive function

(Duncan, 2012). In each model, the same covariates and each of the five individual caregiver rating scales of executive function were examined in turn. The dependent variable in each model was each of the respective performance-based measure of executive function (Happy–Sad Stroop Task, Tapping Test, DCCS).

4.6.1.3 Happy–Sad Stroop Task

In the model testing associations of BRIEF-P scales with the Happy–Sad Stroop Task, a main effect was found for child age ($\beta = .22$, $SE = .00$, $p < .05$), maltreatment ($\beta = -.39$, $SE = .01$, $p < .01$) and for the interaction term maltreatment risk x emotional control ($\beta = .26$, $SE = .00$, $p < .05$). No main effect was found for the emotional control scale, consistent with the correlation analyses. Neither simple slope was found to differ significantly from 0 in post-hoc tests with maltreatment risk as a moderator. The interaction was therefore probed based on emotional control as the moderator variable, with simple slope analysis finding that maltreatment was significantly associated with the Happy–Sad Stroop Task at low levels of emotional control ($\beta = -.66$, $SE = .02$, $p < .05$), but not high levels ($\beta = -.11$, $SE = .01$, $p = .29$). Thus, inconsistent with the hypothesis, maltreatment risk did not moderate the association between caregiver ratings of emotional control and performance of the Happy–Sad Stroop Task. It was not possible to account for the alternate finding that emotional control moderated the relationship between the Happy–Sad Stroop Task and maltreatment risk.

Table 4.4

Test of Maltreatment Risk as a Moderator of the Association Between Caregiver Rating Scales and Performance Measures of Executive Function

Predictor variable	Happy–Sad Stroop Task			Tapping Test			DCCS		
	<i>B</i>	<i>SE</i>	β	<i>B</i>	<i>SE</i>	β	<i>B</i>	<i>SE</i>	β
<i>Model 1</i>									
Child age	.00	.00	.22*	.01	.00	.28**	.08	.03	.03
Ethnicity (Indigenous)	-.04	.04	-.09	-.15	.07	-.20*	-1.62	.67	-.23*
Maltreatment (Count)	-.03	.01	-.26*	-.08	.02	-.39**	-.30	.21	.16
BRIEF-P Inhibit	.00	.00	-.02	.00	.00	.01	-.03	.03	-.11
Maltreatment x BRIEF-P Inhibit	.00	.00	.06	.01	.00	.15	0.6	.03	.21*
<i>Model 2</i>									
Child age	.00	.00	.24*	.01	.00	.27**	.01	.03	.03
Ethnicity (Indigenous)	-.02	.04	-.05	-.16	.07	-.20*	-1.61	.70	-.23
Maltreatment (Count)	-.03	.01	-.28**	-.07	.02	-.32**	-.24	.19	-.13
BRIEF-P Shift	.00	.00	.11	.00	.00	.00	-.00	.05	-.01
Maltreatment x BRIEF-P Shift	.00	.00	.02	.00	.00	.03	.02	.04	.05
<i>Model 3</i>									
Child age	.00	.00	.20*	.01	.00	.26*	.01	.03	.03
Ethnicity (Indigenous)	-.01	.04	-.01	-.13	.07	-.17	-1.55	.71	-.22*
Maltreatment (Count)	-.05	.01	-.39**	-.09	.02	-.39**	-.28	.22	-.15
BRIEF-P emotion control	.00	.00	-.07	.00	.00	.01	-.00	.05	-.00

Predictor variable	Happy–Sad Stroop Task			Tapping Test			DCCS		
	<i>B</i>	<i>SE</i>	β	<i>B</i>	<i>SE</i>	β	<i>B</i>	<i>SE</i>	β
Maltreatment x BRIEF-P emotion control	.09	.00	.26*	.01	.00	.14	-.03	.05	.06
<i>Model 4</i>									
Child age	.00	.00	.20	.01	.00	.25	.01	.03	.04
Ethnicity (Indigenous)	-.03	-.04	-.06	-.14	.07	-.18	-1.73	.70	-.25
Maltreatment (Count)	-.02	.01	-.20	-.07	.02	-.29	-.29	-.19	-.15
BRIEF-P Working Memory	-.00	.00	-.11	-.00	.00	-.16	.00	.03	.02
Maltreatment x BRIEF-P Working Memory	.00	.00	-.02	.00	.00	.04	.03	.03	.10
<i>Model 5</i>									
Child age	.00	.00	.22*	.01	.00	.28**	.01	.03	.05
Ethnicity (Indigenous)	-.03	.04	-.06	-.16	.08	-.20*	-1.81	.68	-.23**
Maltreatment (Count)	-.03	.01	-.21	-.08	.02	-.34**	-.42	.21	-.23*
BRIEF-P Plan/Organise	-.00	.00	-.12	-.00	.00	-.06	.03	.05	.10
Maltreatment x BRIEF-P Plan/Organise	.00	.00	.03	.00	.00	.10	.10	.05	.20

Note. DCCS = Dimensional Change Card Sort. * $p < .05$. ** $p < .01$.

4.6.1.4 Tapping Test

Despite the significant association between Tapping Test and the BRIEF-P scales of Inhibit, Working Memory and Plan/Organise found in the bivariate correlations, the regression models showed no main or interaction effects between them. Thus, inconsistent with the study hypothesis, maltreatment risk did not moderate the association between rating scales and the performance measure of the Tapping Test.

4.6.1.5 DCCS

In the model testing associations between BRIEF-P scales and the DCCS, a main effect for child ethnicity ($\beta = -.23$, $SE = .67$, $p < .05$), as well as the interaction term for maltreatment risk x inhibit ($\beta = .21$, $SE = .03$, $p < .05$) were found. No other interaction effects for other BRIEF-P scales were evident. Thus, consistent with Study 1's prediction, child maltreatment risk moderated the association between the caregiver rating measure of executive function (Inhibit scale) and the direct measure (DCCS). Simple slope analysis of these interactions indicated that the Inhibit scale was significantly associated with DCCS at low levels of maltreatment ($\beta = -.31$, $SE = .03$, $p < .05$), but not at high levels of maltreatment ($\beta = .10$, $SE = .04$, $p = .50$). Thus, consistent with the hypothesis, the BRIEF-P Inhibit scale was correlated with the DCCS only in children with absent or low levels of maltreatment.

4.7 Discussion

Study 1 examined the relationship between caregiver rating and performance measures of executive function in a sample of maltreated and non-maltreated preschoolers. The profile of BRIEF-P rating *T* scores for the maltreated children was generally more elevated (indicating worse executive function) relative to the non-maltreated group across both clinical scales and indexes. The hypothesis that caregiver ratings on the BRIEF-P scales would be correlated with the three performance-based executive function measures was only partially supported. Only five of a possible 15 correlations were statistically significant, thus

only a weak association was found between caregiver rating scales and performance measures of executive function. The second hypothesis proposed that the association between BRIEF-P scales and performance-based executive function measures would be moderated by child maltreatment risk. This hypothesis was only partially supported as the association between DCCS and the BRIEF-P Inhibit scale was found to be moderated by the level of maltreatment risk. No other moderating effects were observed in other associations between measures.

The maltreated children had higher mean *T* scores on all BRIEF-P clinical scales and indexes, reflecting lower ability relative to the non-maltreated children. Overall, the profile of BRIEF-P scores in the maltreated group relative to the non-maltreated group was more variable, with greater fluctuations across the clinical scales and indexes. For example, the Inhibit scale was elevated in comparison to the Shift scale only in the maltreated children. The Inhibit scale was rated as most impaired in the maltreated group, which is not surprising given previous reports of impulsivity, inattention and hyperactivity among maltreated preschoolers (Lewis, Dozier, Ackerman & Sepulveda-Kozakowski, 2007; Pears et al., 2010). In comparison, the most commonly rated difficulty in the non-maltreated group was Working Memory. The Shift scale was reported as the least impaired executive function scale in the maltreated group, which is surprising as this scale has also been shown to tap affective dimensions of control similar to emotional control (Sherman & Brooks, 2010). The Shift scale measures the ability to flexibly switch between tasks, mindsets (e.g., comparing colours then shapes) or problem solving tasks. The parents in the maltreated group tended to rate their children as having adequate abilities on this scale, with fewer problems in rigidity or inflexibility (Gioia et al., 2003). Possible explanations for the less elevated score in this domain include potential reporter bias and the theory that maltreated children are more exposed and therefore more immune to inconsistent routines, chaos or constant change.

Previous research has found links between home chaos, parenting and negative child outcomes (Hardaway, Wilson, Shaw & Dishion, 2012). Thus, the finding may reflect that parents living in more chaotic, less-structured homes would have lower expectations of their child's adjustment to changes in routines or tasks. Finally, the percentage of children with clinically significant scores on the BRIEF-P indexes was higher in the maltreated than the non-maltreated group. This suggests that maltreated children had a higher relative probability than non-maltreated children of obtaining clinically significant scores on the BRIEF-P.

Findings from Study 1 revealed a limited number of weak to moderate correlations between BRIEF-P scales and cognitive measures of executive function, consistent with a previous review that found only modest degrees of correlations between measures (Toplak et al., 2013). Given that previous studies involved mostly clinical samples of neurologically impaired children, it is surprising that there were not more significant correlations in Study 1, which included children with lower levels of executive function impairment and no clinical diagnoses. There were some anticipated patterns of correlations between performance measures and similarly named rating scales that purportedly measured the same construct. For example, the Happy–Sad Stroop Task and Tapping Test, by nature of their working memory requirements (also inhibitory control), were correlated with the BRIEF-P metacognitive scales of Working Memory and Plan/Organise (Isquith et al., 2013; Sherman & Brooks, 2010). This finding contrasted with that of a study by Bodnar et al. (2007) conducted on an older clinical sample of children, in which the BRIEF metacognitive scales were not correlated with performance measures of executive function (the Continuous Performance measure, which tapped inhibition and attention). This discrepancy between findings may be accounted for by the variability in measures or the lack of specificity of some measures to tap a specific executive function component (Isquith et al., 2013).

On the whole, the results of Study 1 indicated a somewhat stronger association between caregiver rating scales and performance-based measures of executive function than has often been found in previous measurement research (e.g., Liebermann et al., 2007; Mahone & Hoffman, 2007). This may be due to the differences in sample characteristics, as the study by Mahone and Hoffman (2007) was conducted on children with ADHD, who have been shown to exhibit increased impulsivity and working memory problems in real-world settings compared with structured laboratory contexts (Mahone & Hoffman, 2007). Similarly, the study by Liebermann et al. (2007) sampled a wide age range of preschoolers, compared to the narrow age range in the current study. Further, the findings may be attributed to the variability in measures between the studies, as the investigation by Liebermann et al. (2007) did not include all scales of the BRIEF-P and used ‘hot’ (i.e., a gift delay task) rather than ‘cool’ performance-based executive function measures.

There was a lack of association between the performance measures of the Happy–Sad Stroop Task and the BRIEF-P Inhibit scale, both of which purportedly measure the same construct (Anderson & Reidy, 2012; Bodnar et al., 2007). A possible explanation is that the measures differ in their conceptualisation of ‘hot’ and ‘cool’ inhibitory control tasks. Items measured by the BRIEF-P Inhibit scale typically involve a child’s modulation of impulses for an emotionally arousing task, within the child’s social context (e.g., ‘has trouble putting the brakes on his/her actions after being asked’) (Denckla, 2002; Zelazo & Carlson, 2012). Further, methodological differences in the measures’ test conditions (e.g., high degree of structure in performance measures of Happy–Sad Stroop Task) may also account for the poor agreement between these measures of inhibitory control (Denckla, 2002). In contrast to the Happy–Sad Stroop Task, the Tapping Test was correlated with the BRIEF-P Inhibit scale. Both these measures tap inhibitory control; however, the latter requires a motor response while the former requires a verbal response, which is arguably a more complex cognitive

processing task for young children whose language processing is under-developed (Anderson & Reidy, 2012). Hence, these factors provide plausible reasons for the lack of association between these two types of inhibitory control measures.

Among the performance-based measures, the DCCS correlated the least with BRIEF-P scales. This contrasts with prior research that found that the DCCS was related to teacher ratings of executive function (Duncan, 2012). This may be explained by the simple two-dimensional (colour and shape) scoring system adopted for this study, in contrast to the complex three-dimensional version (size, colour and shape) used previously (Duncan, 2012). Nonetheless, the DCCS measure approached significance with the BRIEF-P Inhibit ($p=.07$) suggesting that the two are assessing similar construct of inhibitory control. According to Diamond et al. (2005), DCCS taps inhibitory control more than cognitive flexibility.

Finally, in the test of moderation, the findings only partially supported the hypothesis that the association between rating scales and performance measures was moderated by the environmental factor of maltreatment risk. Only the BRIEF-P Inhibit and the DCCS were more closely related in children with low severity of maltreatment compared to those with high severity, which suggests some inconsistencies in associations between measures across the sample. The DCCS was not significantly related to any other executive function variable (aside from the Happy–Sad Stroop Task), yet was significantly related to caregiver ratings of executive function in low-risk children. One can speculate that there is less convergence between measures in maltreated children, because maltreatment has a greater impact on child inhibition in the home than in the clinic. Although Study 1 did not find a pattern of consistent moderation across all rating scales and performance measures of executive function, as reported in prior research (Duncan, 2012), the findings provide preliminary support for the notion that associations between measures may vary according to environmental factors.

Despite the inconsistent relationship between caregiver rating scales and performance measures, the findings support the validity of both these executive function measurement approaches for assessing maltreated children. First, in line with prior studies that have used executive function rating scales to characterise performance among different clinical groups of children (e.g., ADHD, traumatic brain injured) (Mahone & Hoffman, 2007; McCandless & O’Laughlin, 2007), Study 1’s findings were used to create a profile of norm-based executive function scores. The findings provide preliminary evidence that the profile of BRIEF-P scores for the maltreated group relative to non-maltreated group was characterised by more elevated scores and greater fluctuations among the scales. In addition, there were higher percentages of clinically significant scores in the maltreated group relative to the non-maltreated group. Second, the limited significant associations between rating and performance measures suggest that these measurement approaches may capture unique aspects of executive function. Thus, in clinical contexts, the use of both measures may provide supplementary information on the child’s executive function abilities across contexts and varying informant perspectives (e.g., Toplak et al., 2013).

While Barkley and Fischer (2011) advocated that direct assessments of executive function be abandoned and substituted by rating scales, other researchers argued that multi-method executive function assessments reduce the risk of reporter bias and provide more comprehensive information beyond that obtained through caregiver ratings (Willoughby, 2013). For example, observations of poor performance of children in performance-based measures provide clues as to how those children would perform in less-structured or distracting environments. Thus, performance-based assessments provide clinicians with information that can be utilised to make recommendations for appropriate environmental modifications or learning supports. Likewise, caregiver or teacher ratings of child executive function may provide information that can guide training programs that address specific

occupational problems the child may be experiencing. The inclusion of both assessment approaches provides the clinician with a broader understanding of maltreated children's functioning across different settings.

4.8 Limitations and Future Directions

The results of Study 1 should be interpreted in light of a number of limitations that can be addressed by future research. First, given that only one regression model out of fifteen analysed was found to be significant at a conservative value of significance ($p < .05$), caution must be taken in interpreting this result. While this result suggests that one specific caregiver rating scale (BRIEF-P Inhibit) and performance measure of executive function (DCCS) are correlated in children with absent or low levels of maltreatment, a lower level of significance (e.g., $p < .01$, or $p < .001$) should have been used to protect against chance significant findings. Second, given that Study 1 used only three performance-based executive function measures, the use of a more comprehensive battery of measures may be more sensitive in capturing associations between measures (McAuley et al., 2010). It would be fruitful for future studies to incorporate more comprehensive normative-based, executive function batteries for assessing a wider age range of children (e.g., NIH Toolbox, Weintraub et al., 2013). Given that the three performance measures in the current study captured only 'cool' executive function, future research might include performance measures that recruit both 'cool' and 'hot' executive function abilities. It is likely that the rating scales of executive function index more 'hot' executive function abilities, which may correlate more with 'hot' performance measures of executive function (e.g., gambling or delayed gratification tasks). Third, this study did not examine executive function as a unitary construct, despite the increased evidence for a single-factor structure in the early childhood period (Wiebe et al., 2011). Given that the BRIEF-P is based on a multi-dimensional (three-factor) construct of executive function, it was logical to examine executive function as a construct consisting of

multiple dimensions. Nevertheless, further research could extend these endeavours and compare measures using a unitary latent structure of executive function (Carlson & Wang, 2007). In addition, Study 1 relied on caregivers as key informants, and in high-risk samples there is a risk that caregivers will under- or over-report their child's problems. Inviting preschool teachers' participation in future studies would provide additional data and help minimise the reporter bias in single-informant reporting (Denckla, 2002). Further research on discrepancies between performance-based and informant rating scales of children's self-regulation is critical to discern the extent to which discrepancies in measurement are driven by differences in the child's behaviour across contexts versus rater-specific factors, including bias or varying perspectives (Dirks, De Los Reyes, Briggs-Gowan, Cella, & Wakschlag, 2012).

The strengths of Study 1 included the use of well-established executive function measures, and a unique sample of maltreated and non-maltreated preschoolers. The sample size of the present study was larger than samples used in prior measurement studies (see Chapter 1). Further, a range of ethnic and socio-economic groups were represented in the study's sample. Importantly, this study accounted for the potential confounding factors of child age, ethnicity and child verbal ability.

The present findings contribute to a greater understanding of the nature and the strength of the relationships between rating scales and performance measures of executive function in children. Study 1 provided a novel, descriptive comparison of a profile of executive function scores in maltreated children relative to non-maltreated children. It was the first study to demonstrate that rating scales and performance measures of executive function were modestly significantly correlated in a sample of maltreated preschoolers. This result reflects previous interpretations by well-known researchers that rating scales and performance measures assess different executive function conceptualisations and

measurements (Anderson & Reidy, 2012; Willoughby, 2013). Study 1 also demonstrated that this association may vary as a function of child environmental characteristics, namely maltreatment (multiplicity of subtypes). This finding provides an important step in understanding the reasons for the association between caregiver rating scales and performance measures of executive function.

4.9 Chapter Summary

This chapter compared executive function in preschoolers using two assessment approaches and found that rating scales and performance measures of executive function were significantly correlated in only one third of total correlations. This finding suggests that rating scales and performance measures are potentially assessing different aspects of executive function and that both approaches may have a role in providing unique information on maltreated children's level of functioning. The findings which suggested that maltreatment risk moderated the association between these measures, highlights the importance of assessing maltreated children with numerous measures rather than singular ones. The following study sought to redress this and examine executive function in maltreated children using a composite score of performance obtained from three performance measures as well as separate scores on individual measures.

Chapter 5: Study 2—Impact of Child Maltreatment and Parental Emotion Socialisation on Child Executive Function

Despite considerable research in child maltreatment, there is a limited understanding of the specific cognitive domains at risk during the early childhood years (ages 3–6) prior to school entry (Pears & Fisher, 2005). Earlier studies of older, maltreated children have sought to examine deficits in more general cognitive domains such as IQ or school achievement (e.g., reading, spelling) (DeGregorio & McLean, 2013; Jaffee & Maikovich-Fong, 2011; Trickett & McBride-Chang, 1995). In the search for more malleable, protective processes that may reduce the impact of maltreatment on child outcomes, research has turned to identifying higher cognitive processes of executive function, skills known to contribute to academic functioning in childhood. Few studies have identified risks for executive function in preschoolers known to child protection services. Despite the research reported in Chapter 2 that demonstrated links between responsive care giving and specific aspects of executive function, no studies have investigated the moderating effect of parenting on children's executive function in maltreated preschoolers. This study examines the unique and interactive contributions of maltreatment and ERSB's on preschoolers developing executive function. Given the limited maltreatment prevention programs, this research is important for identifying specific parenting behaviours as a potential domain for early intervention.

5.1 Construct of Executive Function and Developmental Significance

Executive function or cognitive control is a set of interrelated higher-order cognitive processes often measured in terms of individual performances of tests that capture working memory, inhibitory control and cognitive flexibility (Diamond, 2013). Although many models of executive function have characterised the construct by these separate dimensions, the results of factor analytic studies suggests that executive function in early childhood is a

unitary structure, consisting of interrelated but not distinct components (Wiebe et al., 2008; Wiebe et al., 2011). Executive function is important for academic success and more strongly associated with school readiness than IQ or early achievement scores (Blair, 2002; Diamond et al., 2007). Early childhood measures of self-control, a related aspect of executive function, have also been found to predict health, wealth and social outcomes in adulthood (Karoly, 1993; Moffitt et al., 2011). Hence, research that investigates the risk factors associated with early childhood executive function may inform interventions to promote school readiness, achievement and socio-emotional adjustment. Evidence from two largely separate bodies of research suggests that executive function may be compromised by adverse caregiving (e.g., orphanages) (e.g., Loman et al., 2012; Pollak, Nelson, Schlaak, Greber & Wewerke, 2010), or conversely, enhanced by positive parenting (e.g., warmth, positive support) (for a review, see Fay-Stammach, Hawes & Meredith, 2014). Due to the largely distinct programs of research out of which these respective findings have emerged, few studies of early childhood executive function have examined the consequences of maltreatment alongside more specific parenting dimensions of emotion socialisation (Eisenberg et al., 1998).

5.1.1 Associations Among Early Stress, Maltreatment, Child/Family Risk Factors and Developing Executive Function

The development of executive function depends on the integrity of the prefrontal cortex system, which functions for planning and directing motor, affective and social behaviour over time (Kolb et al., 2012). Due to the prolonged development of the prefrontal cortex system, its structure and function are shaped by environmental conditions and social experiences that can be both positive and enriching (e.g., stimulation, responsive caregiving) or negative and disruptive (e.g., maltreatment, poverty). This prefrontal cortex system-based cognitive system is thought to be more sensitive to environmental influences during periods of rapid neural growth or ‘plasticity’, particularly the early childhood years (Kolb et al.,

2012; Pechtel & Pizzagalli, 2011). According to the neurobiological model of early stress, prolonged exposure to maltreatment in the form of neglect, physical, sexual or emotional abuse evokes a young child's sense of fear, threat or anxiety and results in disrupted stress responses (termed allostatic load). Alterations in stress systems exert a negative effect on brain structure, neurophysiology and function, leading to increased states of emotional over-arousal (e.g., hypervigilance, hyperactivity) and reduced capacity to regulate volitional attention and thought, including executive function abilities (De Bellis, 2001; McCrory et al., 2010; McEwen, 2012).

Within typical families, the quality of caregiving in the parent-child relationship is theorised to promote the development of executive function in young children (Bernier et al., 2010). Consistent with this theory, the literature review in Chapter 2 found that positive domains of parenting—including responsiveness, stimulation and scaffolding—are associated with child executive function development (Fay-Stammbach, Hawes & Meredith, 2014). Contrary to the effects of enriched, positive caregiving on executive function, neglect and deprivation experienced by adopted orphans has been associated with child executive function deficits and related behaviour problems (Bos, Zeanah, Fox & Nelson, 2009; Pollak et al., 2010). Care in these Romanian orphanages was characterised by frequent changes in caregivers and few opportunities for one-on-one emotional attachments. Younger neglected children adopted under 2 years of age from these orphanages have been found to have less severe executive function impairments and behaviour problems, relative to older adopted children (Hostinar, Stellern, Schaefer, Carlson & Gunnar, 2012; Jacobs, Miller & Tirella, 2010). Collectively, these studies suggest that prolonged early exposure to unresponsive caregiving, particularly in the sensitive period of early childhood, may be detrimental to executive function development (Merz & McCall, 2011).

Belsky and de Haan (2011) cautioned that severe neglect experienced in orphanages involves much more than unresponsive caregiving and that findings should not be generalised to children exposed to less extreme forms of maltreatment. However, relatively less is known about whether children exposed to family-level maltreatment display executive function deficits. Studies mostly of school-aged maltreated children (8–16 years) have reported broad neurocognitive problems in processing speed, inhibition, auditory and working memory (DePrince et al., 2009; Mezzacappa, Kindlon & Earls, 2001), abstract thinking and attention (Beers & De Bellis, 2002), spatial working memory (Augusti & Melinder, 2013), and everyday memory (Moradi, Doost, Taghavi, Yule & Dalgleish, 1999). Though these findings support an association between maltreatment exposure and multiple neurocognitive problems in school-aged children, the results cannot be generalised to younger preschoolers for whom the components of executive function are less differentiated (Wiebe et al., 2008).

Studies of younger maltreated children have focused largely on foster children who have experienced severe levels of maltreatment, and have had to be removed from their home and placed in foster families. Many executive function studies of foster children have reported inconsistent findings. In one study, foster preschoolers performed similarly to their non-foster peers in executive function performance measures (Pears & Fisher, 2005), while in two other studies, foster children performed worse in tests of inhibitory control (Lewis et al., 2007; Pears et al., 2010). Determining the unique effects of maltreatment on foster child executive function is made more difficult by the presence of many other contextual factors, including separation from primary caregivers and quality of foster placement. None of these previous studies have accounted for multiple contextual risk factors that may confound the effects of maltreatment on executive function, nor have they considered the quality of the foster caregiving environment (Pears et al., 2010).

In contrast to the research on post-institutionalised and foster children, there have been relatively few studies that have examined executive function in children with lower levels of maltreatment who still reside with their families. A study by Kim-Spoon et al. (2012) conducted on a group of children (aged 4–7) known to child protection services, found that physical abuse was related to poor executive function (based on parent reports) and subsequent externalising problems. In contrast, a study of preschoolers recruited from child protection services found no group differences in inhibitory control measures between maltreated and non-maltreated children (Cipriano-Essel et al., 2013). The authors of the latter study attributed their unexpected findings to different demographic covariates (e.g., child IQ) between the groups. Neither of these studies considered specific child and family risk factors associated with maltreatment (e.g., ethnicity, parental depression) nor the multiplicity of maltreatment type/s that have differential effects on child outcomes (Kim & Cicchetti, 2010; Trickett & McBride-Chang, 1995). Indeed, there is emerging evidence that both distal, demographic (e.g., low SES, ethnicity, single family) and proximal risk factors (e.g., parental depression) are negatively associated with executive function development (e.g., Rhoades et al., 2011; Noble et al., 2007, Hughes et al., 2013). Further, given that the risk factors of parental depression, low-income (Cicchetti, 2012) and ethnicity (Haskett, Allaire, Kreig & Hart, 2008) often co-occur in families of maltreated children, it is important to differentiate the effects of maltreatment in and of itself from child and family risks on executive function (Briggs-Gowan et al., 2010; Fishbein et al., 2009). Moreover, Cicchetti and Valentino (2006) maintain that multiple child- and family-level risk factors converge and interact to undermine development in maltreated children. Given that few studies have controlled for an extensive array of family covariates to examine the unique effects of maltreatment on child executive function, the present study will consider multiple child and family variables.

5.1.2 Associations Among Maltreatment, Quality of Parenting and Developing Executive Function

There has been a growth in identifying relational mechanisms within the family context associated with child executive function, as detailed in Chapter 2. The systematic review demonstrates that good parenting quality facilitates children developing executive function, through specific parenting practices of teaching/stimulation, scaffolding, responsiveness and supportive control (discipline). One limitation of this research is that all the studies were conducted on educated, middle-class or low-risk families of preschoolers. Consequently, it cannot be assumed that parenting processes operating in typical families would also be associated with child executive function in high-risk, maltreating families.

Very few maltreatment studies have examined the effects of care giving quality on child executive function. One noteworthy, randomised control study provided strong evidence of a causal relationship between positive parenting and child executive function. The study found that maltreated foster children whose foster carers received an attachment-based parenting program had higher performances of executive function measures (cognitive flexibility) than those who received a control intervention (Lewis-Morrarty et al., 2012). In a related study of self-regulation, warm, responsive parenting was found to reduce dysregulation of stress hormones in maltreated young children (Cicchetti, Rogosch, Toth & Sturge-Apple, 2011). In other studies of maltreated preschoolers, caregivers' warm autonomy support (scaffolding) was associated with child inhibitory control for negatively temperamental children (Cipriano-Essel et al., 2013) and responsive parenting moderated the association between executive function (parent report) and externalising disorders (Kim-Spoon et al., 2012). In contrast, no relationship was found between caregivers' parental disciplinary style and child executive function in a study of foster preschoolers (Healey & Fisher, 2011). This unexpected finding was attributed to the reluctance of foster carers to self-

report negative parenting styles (Healey and Fisher, 2011). Further, emerging research in related fields has highlighted the protective role of parenting on child development in contexts of adversity. In a study of homeless families in temporary shelters, preschoolers who experienced responsive and supportive parenting were found to have higher executive function and school achievement compared with peers whose parents were insensitive and unsupportive (Masten et al., 2014). Given the considerable variability in the developmental outcomes among maltreated children (Cicchetti, 2012; Rutter, 2012), it is likely that specific parenting behaviours may exert a protective influence on the development of executive function in maltreated children

To understand how to protect children experiencing maltreatment, it is important to expand on previous research and identify specific parenting practices that may be potential targets for intervention. The few studies of maltreatment, parenting and executive function have tended to emphasise parents' warmth/responsiveness and autonomy support; however, there has been little examination of other domains of parenting that might promote (or inhibit) children's early regulatory behaviours of executive function.

In their model, Eisenberg et al. (1998) conceptualised parents' ERSBs and identified four ways in which parents socialised their children's emotions: 1) parents' reactions to children's emotions; 2) parents' discussion of emotion; 3) parents' expression of emotion; and 4) parents' selection or modification of the child's situation. Research with normative samples has demonstrated that parents socialise their children's emotions through ERSBs, which foster optimal levels of emotional arousal and learning (for a review, see Eisenberg et al., 1998), while only a limited number of maltreatment studies have shown similar patterns (Shipman et al., 2007; Shipman & Zeman, 2001). One study of maltreated school children found that ERSBs (e.g., emotion coaching) mediated the relationship between maltreatment status and children's adaptive emotion regulation skills. Given that executive function is a

closely related construct to emotion regulation (effortful control) (Liew, 2012), it follows that parents' capacity to provide reassurance, comfort and cognitive strategies to assist their children's emotional distress may also contribute to their executive function abilities.

5.2 Study 2

Study 2 examined the unique and joint contributions of maltreatment risk, parenting quality (ERSBs) and child/family factors to children's individual executive function performance in a diverse sample of maltreated and non-maltreated preschoolers. This study extends the literature in several ways. First, unlike earlier studies, it was important to focus on higher cognitive skills of executive function rather than general cognitive abilities, as executive function is a more robust predictor of developmental outcomes than IQ (Blair & Razza, 2007; Gathercole et al., 2004) Second, there have been few studies conducted on preschoolers from less extreme samples (e.g., orphanages) who still reside with their parents and who have a lower level of maltreatment risk. Third, the study examined specific parenting practices that have been associated with child emotion regulation but have not yet been studied in respect to child executive function in a high-risk sample of preschoolers. Fourth, although there has been increasing attention given to the caregiving influences on executive function development, there has been a tendency for studies of adverse caregiving and typical caregiving to occur in isolation from each other.

The main aim of the current study was to investigate the unique and interactive contributions of maltreatment and ERSBs on preschoolers developing executive function. For this intent, three hypotheses were formulated. First, it was hypothesised that children with a profile of family-level risks would perform significantly lower in executive function measures than children in the comparison group with no identified risk (Jaffee & Maikovich-Fong, 2011). Second, it was hypothesised that maltreatment (multiplicity of maltreatment types) would predict executive function performance, controlling for variables already

associated with executive function (child language, bilingualism and ethnicity and parental education and depression). Based on prior studies of maltreated preschoolers, it was hypothesised that maltreatment risk would be negatively associated with executive function. Finally, it was hypothesised that quality of ERSBs would moderate the association between maltreatment risk and executive function. Guided by previous research (Cipriano-Essel et al., 2013; Kim-Spoon et al., 2012), it was expected that high levels of positive parental responses (e.g., expressive/encouraging, emotion or problem-focused) would mitigate the risk of maltreatment to executive function, or alternatively, high levels of negative parental responses (punitive or dismissing) would intensify the risk to executive function. Findings from Study 2 are expected to inform the development and provision of maltreatment preventive models, especially those that target parent training and children's early self-regulation.

5.3 Methods

5.3.1 Participants

Participants were preschool boys ($n = 65$) and girls ($n = 42$) aged 4 and 5 years ($M = 4.75$, $SD = 0.57$), and their mother ($n = 95$) or father ($n = 12$). For the present analysis, all participants recruited from the foster care agencies and the early intervention program, were classified into the maltreatment risk group (MR) ($n = 58$). These children had been identified as being exposed to at least one risk factor that adversely affected parenting capacity and/or child wellbeing (e.g., domestic violence, parental drug misuse, parental mental health, lack of social support). Children recruited from community preschools with no known involvement with child protection services (confirmed by the parent and authorised supervisor of the preschool) were classified into the community comparison group (CC) ($n = 49$). The demographic characteristics and maltreatment classifications of the two groups are summarised in Table 1. The MR and CC groups were similar on most key demographic

variables of child age, maternal age (age at the child's birth) and maternal highest education and culturally diversity (see Table 5.1) Males comprised 55% of the MR group and 67% of the CC group. The MR group had a greater proportion of single-parent households and families who received social welfare than the CC group. Of note, a significant proportion (41%) of mothers in the MR group had a university education. Children in the MR group were classified according to what subtype of maltreatment they had experienced, as described in Chapter 3. Within the MR group, 71% had experienced emotional maltreatment, 45% neglect, 19% physical abuse and 2% sexual abuse. Similar to previous reports of comorbidity of subtypes of maltreatment (Barnett et al., 1993), in this study 30% had experienced two subtypes of maltreatment. Details on the recruitment process are outlined in Chapter 3.

5.3.2 Measures

Children's maltreatment type, executive function performance of three cognitive tasks (Happy–Sad Stroop Task, Tapping Test and DCCS) and verbal language (PPVT-III) were assessed using the methods described in Chapter 3. Parents' self-reported ERSBs (CCNES) and depression (DASS) were assessed using the methods described Chapter 3.

Table 5.1

Demographic Characteristics of Groups

Variable	MR <i>n</i> = 58	CC <i>n</i> = 49
Mean child age in months	56.4 (<i>SD</i> = 7.6)	57.8 (<i>SD</i> = 5.7)
Child gender		
Female	26 (45%)	16 (33%)
Male	32 (55%)	33 (67%)
Child culture		
Indigenous	7 (12%)	2 (4%)
Parent born overseas	18 (31%)	21 (43%)
Bilingual	7 (12%)	13 (26%)
Caregiver/parent type		
Mother/foster	43 (90%)	43 (88)
Father/foster	6 (10%)	6 (12)
Family structure		
Single-parent	30 (52%)	6 (12)
Married/partner	28 (48%)	43 (88)
Maternal mean age at birth of child	31.3	31.5
Paternal mean age at birth of child	35	33.6
Maternal university education	24 (41%)	29 (59%)
Welfare receipt	34 (58%)	9 (18%)
Maltreatment type		
Neglect	—	26 (45%)
Emotional abuse	—	41 (71%)
Physical abuse	—	11 (19%)
Sexual abuse	—	1 (2%)

Note. MR = Maltreatment Risk, CC = Community Comparison.

5.3.3 Procedure

With the exception of the foster care children, each child, accompanied by their parent/caregiver, attended a single 40-minute session at the preschool or early intervention centre. The foster care children were visited at their homes by the researcher so as to reduce

their travel demands since they came from a wide geographic region. First, parent/caregivers signed informed consent and permission for their child's participation, according to procedures approved by the Research Ethics Committee at the University of Queensland; the University where the researcher was initially enrolled. The child was then administered three performance-based executive function measures followed by a verbal language test.

Caregivers completed a brief demographic questionnaire and a standardised questionnaire for rating their child's executive function. The researcher administered, collated and scored all child measures and caregiver questionnaires. Immediately following the session, the child was given a set of decorative stickers. Caregivers received a written report summarising the child's test performance and their parent responses to the standardised measures.

5.3.4 Data Analytic Plan

Preliminary analyses were conducted to examine patterns of normality and missing data. Due to skewness, the DV (executive function performance measures), parenting socialisation and depression variables were log transformed. As there were no missing data for the executive function measures and other variables, it was not necessary to use estimation techniques. Next, bivariate correlations were used to identify the covariates of child executive function. This was followed by one-way group analysis of covariance (ANCOVA) to test for differences between the at-risk and CC groups on the DV. The independent variable in this analysis was risk status, comprising two levels (MR and CC) based on the presence of one or more family-level risks, or their absence. Four covariates were entered: ethnicity, child language, highest maternal education and parental depression. Finally, linear regression analyses were conducted to examine the independent contributions of maltreatment risk (0 – 4, 0 = absence) and interactions between parenting and maltreatment to child executive function. This final analysis involved excluding the foster children as it was important to have a similar basis on which to measure parent emotion

socialisation. Parent emotion socialisation is assumed to reflect parenting behaviours that the child has been exposed to (and subsequently socialised by) throughout their childhood, hence foster children were not included as they had only lived with their caregivers for the previous two years.

A separate hierarchical regression was performed for each executive function measure (composite and three individual tests) using scores from the five subscales (problem-focused, emotion-focused, expressive encouragement, minimisation, punitive reactions). This resulted in eight separate regression tests. In each of these regressions, the composite or individual executive function measure was the DV, with independent variables tested in three blocks. The first step (Block 1) showed the total effect of child (child age, ethnicity and bilingualism), parent covariates (maternal education, depression) and maltreatment risk on executive function. The second step (Block 2) added the predictor variable of the parenting domain (five subscales). In Block 3, the interaction term for maltreatment count x parenting domain was entered to determine whether maltreatment risk would moderate the effects of parenting on executive function, controlling for effects through MR and parenting.

As recommended when testing interaction terms in regression (Aiken & West, 1991) all predictor variables were first entered. The VIF (Velleman, 1981) was used to ensure no violation of multicollinearity. Significant interaction terms were probed post-hoc using the method of simple slope analysis outlined by Aiken and West (1991), which is recommended for interpreting moderating effects in child and family research (Holmbeck, 2002). This method computed conditional moderator variables, corresponding to + 1 *SD* from the centred value for each participant in order to test the significance of the respective independent variable at high/low levels of the moderator variable.

5.4 Results

5.4.1 Descriptive Statistics

Descriptive statistics for the key study variables (child age, ethnicity, bilingualism, maternal education and parental depression and executive function), and correlations among these variables, are presented in Table 5.2. Child age, ethnicity and bilingualism were all significantly correlated with at least one measure of executive function. Executive function was also correlated with depression (DASS) such that parents with higher levels of depression had lower scores on DCCS. These covariates were included in all analyses as relevant demographic variable, in addition to maternal education which is a well-known theoretically derived correlate of executive function. As other parent socio-demographic variables of parental age, family structure and parental source of income (receipt of welfare payments) were not related to the executive function variables, these were not included in subsequent analyses. Similarly, the child variables of gender and receptive language were not related to executive function variables. Previous researchers have suggested that executive function tasks may require a certain level of verbal competence however increases in verbal ability beyond a threshold level may have little impact (Hughes et al., 2010).

Table 5.2

Descriptive Statistics and Correlations Among Key Study Variables

	1	2	3	4	5	6	7	8	9	10
1. Child age in months	1									
2. Child bilingualism	-.11	1								
3. Maternal education	.00	.23*	1							
4. Child ethnicity (Indigenous)	-.15	-.14	-.31**	1						
5. Child verbal language	.01	-.34**	.11	-.06	1					
6. Maternal depression	.02	-.01	.23*	.02	.05	1				
7. Executive function comp.	.23*	.18	.17	-.28**	.11	-.15	1			
8. Happy–Sad Stroop Task	.26**	.22*	.14	-.17	.03	.03	.55**	1		
9. Tapping test	.26**	.11	.08	-.25**	.16	-.02	.70**	.26**	1	
10. DCCS	.08	.12	.15	-.30**	.01	-.27**	.71**	.31**	.23*	1
<i>M</i>	57	1.19	2.26	1.08	4.67	1.55	-.28	-.23	-.34	1.66
<i>SD</i>	6.84	.40	.83	.28	.13	1.07	-.32	.18	.48	.61

Note. DCCS = Dimensional Change Card Sort. * $p < .05$; ** $p < .01$

5.4.1.1 Hypothesis 1: Differences in Executive Function Between Children with High Versus Low Family-level Risk Factors

This hypothesis was supported by a one-way ANCOVA that indicated a statistically significant difference between children with high (MR group) and low (CC group) family-level risk factors in executive function (composite score), controlling for covariates. Mean values of executive function for the MR and CC groups are shown in Table 5.3. There was a significant effect of family-level risk on executive function after controlling for child ethnicity and language, and maternal education and depression ($F [2,164] = 5.21, p = .00, \eta^2 = .031$) and comparisons showed that executive function ($p < .05$) was significantly lower in the MR group.

Table 5.3

Mean Values for Executive Function for High and Low Family Risk Groups

Level of family risk factors	Executive function (composite)			
	Observed mean	Adjusted mean	SD	n
High (MR)	-0.18	-0.20	0.05	58
Low (CC)	-0.37	-0.34	0.04	49

Note. MR = Maltreatment Risk, CC = Community Comparison

5.4.1.2 Hypotheses 2 and 3: Maltreatment (risk) Will Independently and in Interaction with Parenting Variables Predict Executive Function

Linear hierarchical regression was used to test the hypothesis that multiplicity of maltreatment types would be uniquely associated with executive function, and the hypothesis that parental emotion socialisation would moderate this association. Regression statistics for the full model are reported in Table 5.4. Significant main effects in the model testing predictors of the executive function composite score were ethnicity ($\beta = -.35$, $SE = .09$, $p < .01$), parental depression ($\beta = -.21$, $SE = .02$, $p < .05$), maltreatment ($\beta = .22$, $SE = .05$, $p = .05$), expressive encouragement responses ($\beta = .27$, $SE = .13$, $p < .01$), the interaction terms for maltreatment x emotion-focused responses ($\beta = -.31$, $SE = .59$, $p < .05$), maltreatment x minimisation responses ($\beta = -.29$, $SE = .21$, $p < .01$), and maltreatment x punitive responses ($\beta = -.42$, $SE = .24$, $p < .01$). Simple slope analysis of these interactions indicated that maltreatment risk was significantly associated with the executive function composite at low levels of emotion-focused responses ($\beta = -.47$, $SE = .08$, $p < .05$), but not high levels of emotion-focused responses ($\beta = .05$, $SE = .08$, $p = .68$). Likewise, maltreatment was significantly associated with executive function at high levels of punitive responses ($\beta = -.45$, $SE = .07$, $p < .001$), but not low levels ($\beta = .04$, $SE = .07$, $p = .71$). As such, emotion-focused responses appeared to protect against the negative influences of maltreatment, whereas punitive responses appeared to enhanced vulnerability to the deleterious effects of maltreatment on executive function. The interaction term for maltreatment x minimisation

responses was not found to be robust to simple slope analysis (i.e., maltreatment risk was not differentially associated with executive function at either high or low levels of minimisation responses when tested without other interaction terms in the model). The notion that minimisation responses moderated the association between maltreatment risk and the composite executive function index was therefore not reliably supported.

Table 5.4

Test for Maltreatment and Parenting in Predicting Executive Function

Predictor variable	Executive function composite			Happy–Sad Stroop Task			Tapping Test			DCCS		
	<i>B</i>	<i>SE</i>	β	<i>B</i>	<i>SE</i>	β	<i>B</i>	<i>SE</i>	β	<i>B</i>	<i>SE</i>	β
<i>Block 1</i>												
Child age	0.00	0.00	0.09	0.00	0.00	0.17	0.01	0.01	0.12	0.00	0.01	0.02
Maternal education	0.10	0.01	0.06	-0.01	0.01	-0.10	0.02	0.03	0.10	0.00	0.05	-0.01
Child ethnicity	-0.38	0.09	-0.35**	-0.12	0.07	-0.20	-0.34	0.15	-0.21*	-1.00	0.26	-.40**
Child bilingualism	0.10	0.06	0.16	0.08	0.04	0.20	0.07	0.10	0.07	0.10	0.16	0.06
Parental depression	-0.05	0.02	-0.21*	-0.01	0.02	-0.06	0.00	0.04	-0.01	-0.13	0.07	-0.22
Maltreatment (count)	-0.13	0.05	0.22*	-0.04	0.04	-0.12	-0.28	0.10	-0.32**	-0.19	0.16	-0.14
<i>Block 2</i>												
Problem-focused	-0.43	0.31	-0.21	0.10	0.22	0.08	-1.05	0.50	-0.34**	-1.26	0.83	-0.26
Expressive-encourage	0.36	0.13	0.27**	0.10	0.10	0.13	0.37	0.22	0.19	0.22	0.36	0.07
Emotion-focused	0.17	0.24	0.09	-0.06	0.17	-0.05	0.98	0.40	0.33**	0.32	0.67	0.07
Minimisation	-0.04	0.10	-0.05	0.10	0.07	0.18	-0.24	0.16	-0.18	0.15	0.27	0.07
Punitive	-0.07	0.12	-0.07	-0.02	0.08	-0.03	-0.20	0.19	-0.13	-0.33	0.32	-0.14
<i>Block 3</i>												
Mal x problem-focused	-0.88	0.69	-0.19	0.49	0.49	0.19	-3.56	1.12	-0.53**	-1.74	1.85	-0.17
Mal x express-encourage	-0.02	0.24	0.00	0.13	0.18	0.08	0.89	0.40	-0.22*	-0.66	0.67	-0.12
Mal x emotion-focused	1.32	0.59	0.31*	0.72	0.42	-0.29	3.28	0.97	0.50**	1.04	1.60	0.10
Mal x minimise	0.57	0.21	0.29**	0.33	0.15	0.29*	0.19	0.35	0.06	0.85	0.57	0.19
Mal x punitive	0.85	0.24	0.42**	-0.13	0.18	-0.11	-0.91	0.40	-0.30*	-0.55	0.67	-0.33*

Note. DCCS = Dimensional Change Card Sort. Mal = maltreatment; * $p < .05$. ** $p < .01$.

Next, predictors of the executive function measure Happy–Sad Stroop Task were tested among independent variables and the interaction terms as in the prior model. Significant main effects in the model was the interaction term for maltreatment x minimisation responses ($\beta = .29$, $SE = .15$, $p < .05$). Simple slope analysis indicated that maltreatment was significantly associated with high levels of minimisation responses ($\beta = -.35$, $SE = .06$, $p < .05$) but not with low levels of minimisation responses ($\beta = .07$, $SE = .05$, $p = .64$). As such, children of mothers with high levels of minimisation responses were vulnerable to maltreatment effects on executive function (Happy–Sad Stroop Task).

Next, predictors of executive function (Tapping Test) were tested among independent variables and the interaction terms as in the prior model. Significant main effects in this model were ethnicity ($\beta = -.21$, $SE = .15$, $p < .05$), maltreatment ($\beta = -.32$, $SE = .10$, $p < .01$), problem-focused ($\beta = -.34$, $SE = .50$, $p < .05$), emotion-focused ($\beta = .33$, $SE = .40$, $p < .05$), and the interaction terms maltreatment x problem-focused ($\beta = -.53$, $SE = 1.1$, $p < .01$), maltreatment x expressive encouragement ($\beta = -.22$, $SE = .40$, $p < .05$), maltreatment x emotion-focused responses ($\beta = .50$, $SE = .97$, $p < .01$), and maltreatment x punitive responses ($\beta = -.30$, $SE = .40$, $p < .05$). Simple slope analysis indicated that maltreatment was significantly associated with executive function (Tapping Test) at low levels of expressive encouragement ($\beta = -.42$, $SE = .12$, $p < .005$) but not high levels ($\beta = -.01$, $SE = .13$, $p = .92$), with low levels of emotion-focused responses ($\beta = -.56$, $SE = .13$, $p < .001$) but not high levels of emotion-focused responses ($\beta = .05$, $SE = .13$, $p = .73$), and with high levels of punitive responses ($\beta = -.45$, $SE = .13$, $p < .05$) but not low levels of punitive responses ($\beta = .05$, $SE = .13$, $p = .72$). Thus, children of parents reporting more expressive encouragement or emotion-focused responses appeared to be protected from risk of maltreatment to executive function (Tapping Test), whereas children with high levels of punitive responses appeared vulnerable. The interaction term for maltreatment x problem-focused responses was not

found to be robust to simple slope analysis (i.e., maltreatment was not differentially associated with executive function at either high or low levels of problem-focused responses when tested without other interaction terms in the model). The notion that problem-focused responses moderated the association between maltreatment and executive function (Tapping Test) performance was therefore not supported.

Finally, predictors of the executive function (DCCS) were tested among independent variables and the interaction terms as in the prior model. Significant effects in the model were ethnicity ($\beta = -.40$, $SE = .26$, $p < .01$), and the interaction terms for maltreatment x punitive responses ($\beta = -.33$, $SE = .67$, $p < .05$). However, the interaction term for maltreatment x punitive responses was not found to be robust to simple slope analysis (i.e., maltreatment was not differentially associated with executive function [DCCS] at either high or low levels of punitive responses when tested without other interaction terms in the model). The notion that punitive responses moderated the association between maltreatment and executive function (DCCS) performance was therefore not supported.

5.5 Discussion

Understanding the emergence of executive function in maltreated children, and the parenting processes that protect this self-regulatory capacity, has much potential to inform strategies for early intervention. Consistent with neurodevelopmental conceptualisations of the effects of early stress on emerging cognitive capacities, performance-based tests were used to examine whether maltreatment was associated with individual differences in preschoolers' higher cognitive abilities of executive function. As predicted, the children in the sample who had exposure to one or more parental risk factor (MR) were found to have significantly lower executive function (composite score) than the children who had no known involvement with child protection services (CC), after controlling for covariates (ethnicity, verbal language, highest maternal education and parental depression). In addition,

maltreatment risk was found to uniquely predict performance of the executive function composite and the Tapping Test, independent of other associations with child-level factors (e.g., language) and family-level risks (e.g., depression, SES). Further, ERSBs were found to moderate the association between maltreatment risk and executive function in predicting the executive function composite and the individual measures (Happy–Sad Stroop Task and Tapping Test), supporting the notion that positive ERSBs (emotion-focused and expressive encouragement) were a protective factor and negative ERSBs (minimising and punitive responses) were a vulnerability factor.

Study 2 first examined group differences in executive function based on their status of psychosocial/parental risk factors or their membership in the MR or the CC group. Compared to the CC group with no identified risk of maltreatment, the MR group, which included children from foster care agencies and the early intervention group, had been referred through child protection services for having one or more parental risk factor (e.g., parental mental health, parental substance abuse, low social support and inadequate parenting) that posed a threat to the child’s wellbeing. This finding supports previous research that early adversity (distal and proximal family risk factors) is associated with lower levels of early childhood executive function performance (e.g., Hughes, 2011; Rhoades et al., 2011). Children in troubled families are rarely exposed to only one risk factor and evidence suggests that cumulative rather than single risks are associated with compromised executive function in young children (Blair, 2010). Findings from Study 2 echo results of previous research that has linked parental stress (Hughes et al., 2013) and low social support (Brown et al., 2013) to poor cognitive and behavioural regulation in children. At the neurobiological level, chronic exposure to these stressors is likely to alter stress responses that affect prefrontal cortex system-based executive function abilities (Blair, 2010; Evans, 2003).

The findings of Study 2 also clearly demonstrated that multiplicity of maltreatment types uniquely predicted executive function performance (executive function composite and tapping measures) after controlling for child and family covariates (e.g., ethnicity, SES and parental depression). This analysis was based on all children in the sample bar the foster children ($N=15$) who had more severe histories of maltreatment and who no longer lived with their biological parents. This highlights that children exposed to low to moderate family-level maltreatment who continue to reside with their parents have compromised executive function. The present findings reflect past research conducted on post-adopted preschoolers (Hostinar et al., 2012) and foster children (Pears et al., 2010), which also found associations between early maltreatment and lower executive function scores on cognitive performance measures. Study 2's findings, however, conflict with a prior study of maltreated preschoolers in which there were no group-based differences in executive function between maltreated and non-maltreated children, although the authors had attributed this to methodological limitations (Cipriano-Essel et al., 2013). The results here are line with the neurobiological model of early stress, which proposes that adverse caregiving disrupts the normal development of prefrontal cortex system-based cognitive systems (McCrory et al., 2010).

In support of the study's final hypothesis, the main findings suggest that positive ERSBs (high levels of emotion-focused or expressive encouragement) were a protective factor for child executive function, whereas negative ERSBs indexed by high levels of punitive or minimising reactions were a vulnerability factor (Luther & Cicchetti, 2000). These moderating effects of ERSBs were observed when executive function was indexed by the composite measure and also by the single measures (Happy–Sad Stroop Task and Tapping Test). This interaction reflected the classic form of a protective/vulnerability factor, in which positive parenting buffers environmental risk and negative parenting increases risk vulnerability.

There was no moderating effect of parents' problem-focused responses on the association between maltreatment and executive function, which may have reflected the young age of the study's sample. From the end of the early childhood period (5 or 6 years), parents tend to use more cognitive-directed strategies (e.g., cognitive appraisal) in co-regulating their child's emotions, whereas in earlier years, parents provide more hands-on reassurance, comfort or encouragement (Morris et al., 2007). The moderating effect of parenting on the association between maltreatment risk and executive function varied according to the executive function measure used, such that more interactions among variables were evident with the executive function composite and Tapping Task. Executive function indexed by the DCCS was not predicted by maltreatment risk or interactions with parenting, which may be explained by the simple two-dimension (colour and shape sorting) version used in the current sample. Previous studies that have found associations between this executive function measure and maltreatment have used a more challenging version of this test (Hostinar et al., 2012). Further, the results in Study 2 may have reflected differences in specificity or sensitivity among these different measures (motor vs. verbal response). It was interesting to note that both parental depression and ethnicity uniquely predicted executive function, after controlling for covariates. These findings extend previous studies that have linked maternal depression and ethnicity to executive function, and highlight the importance of controlling for these factors in studies of maltreated children (Hughes et al., 2013; Rhoades et al., 2011).

5.6 Limitations and Future Directions

A number of limitations and directions for future research warrant discussion. First, as this study used a cross-sectional design, the directional nature of caregiving effects on executive function is open to alternative explanations, including the role of transactional parent-child dynamics or genetic influences (Leve et al., 2013). Future longitudinal studies

that employ repeated measures could clarify this. Regardless of possible genetic or epigenetic transmission of executive function, experimental studies in animals have demonstrated the unique impact of early neglect on prefrontal cortex system-based cognitive measures (Sanchez, Ladd & Plotsky, 2001). Second, future research should employ observational measures of parenting as self-reported measures may be open to reporter bias in populations of high social risk (Driscoll & Easterbrooks, 2007). Replication of this study using a larger sample and a recently developed normative-based executive function battery (Weintraub et al., 2013) would also strengthen the robustness of these findings. Finally, future work should compare the stability of these findings with a larger sample of fathers, given reports of a differential impact of father-child relationships on child outcome (Harold, Elam, Lewis, Rice & Thapar, 2012).

There were many strengths in Study 2. To the author's knowledge, this study was the first to examine objectively measured executive function performance and ERSBs in a high-risk sample of maltreated children. The sample was a socio-economically and ethnically diverse group of parents and children. The study demonstrated the practicality of using performance-based measures of executive function that were well validated for use with young children. Although a more comprehensive executive function battery would have been optimal, the use of three child-friendly tasks did not overwhelm or fatigue the children. By including specific categorisations of maltreatment types, this study was able to provide a more fine-grained analysis of the effects of maltreatment on executive function. Finally, this study was able to control for an array of child and family risk factors to differentiate the impact of child maltreatment from the consequences of other co-occurring stressors.

Study 2 contributes to a small but growing literature on the importance of parenting in the link between maltreatment and executive function (Cipriano-Essel et al., 2013; Kim-Spoon et al., 2012; Lewis-Morrarty et al., 2012). Given that executive function and parenting

are both malleable to change and central to child development (Carlson et al., 2013), the findings underscore the importance of evidence-based parenting programs and executive function interventions for high-risk families (Cicchetti, 2012; Parenting Research Centre, 2013). It is imperative that future models of maltreatment prevention incorporate parenting strategies that target ERSBs, similar to recently designed attachment-based and emotion-coaching parenting programs (Cicchetti et al., 2011; Havighurst, Wilson, Harley & Prior, 2009; Tarabulsky et al., 2008).

Findings from Study 2 found that child executive function was moderated by both negative (e.g., punitive) and positive styles (e.g., emotion-focused) of ERSBs, which suggests that practitioners working with high-risk families should not only attend to negative or harsh parenting. It is also important to address instances where parents use less emotional displays or infrequently validate their child's emotions, indicating a reduced capacity to support their child's self-regulation. Child protection services are often alerted to heightened displays of harsh or punitive parenting practices; however, workers also need to identify parenting difficulties of a subtler nature. Child protection policy and practice needs to address the current lack of resources for maltreated Indigenous children, as well as improve mental health screening for prospective kinship carers with whom most Indigenous children are placed. These results also indicate the importance of screening for executive function difficulties in maltreated children prior to school, to enable appropriate provision of educational supports to prevent school adjustment and achievement problems (Raver et al., 2011).

Although no maltreatment intervention models currently target child executive function, there are many socio-emotional based early learning programs that could be translated for use in maltreatment prevention programs (Diamond & Lee, 2011; Raver et al., 2011). Further, assessment and interventions to address early cognitive problems should be incorporated into universal child and health clinics, particularly in communities of high social

risk. Finally, increased attention needs to be given to the development of interventions directed towards the prevention of maltreatment. The findings from Study 2 thus demonstrate the potent influence of adverse caregiving on child executive function in the first five years of life, and the urgent need for implementing more effective strategies for reducing this societal illness.

5.7 Chapter Summary

This chapter reported on a study which examined the unique and interactive contributions of maltreatment and ERSB's on preschoolers developing executive function. The key results revealed that multiplicity of maltreatment types was associated with lower executive function scores on performance measures of inhibitory control, working memory and cognitive flexibility. Moreover, high levels of ERSBs involving emotion-focused or expressive encouragement mitigated the risk of maltreatment on executive function, while high levels of parental punitive or minimising reactions was a vulnerability factor. The following chapter addresses the importance of examining the specificity of relations between maltreatment and different aspects of self-regulation, namely emotion and cognitive regulation.

Chapter 6: Study 3—Shared Environmental Processes of Emotion and Cognitive Regulation: A Focus on Child Maltreatment

Emotion regulation and cognitive regulation (also termed executive function) are two core components of self-regulation that are fundamental to children's socio-emotional competence, academic achievement and mental health (Calkins & Marcovitch, 2010). Historically, emotion and cognitive regulation have most often been studied in separate research fields, reflecting the view that these processes are distinct and independent (Liew, 2012). In recent years, however, advances in theoretical and empirical research have supported a more integrated model in which emotion and cognitive regulation operate interdependently for the refinement of complex behavioural self-regulation (Calkins & Marcovitch, 2010; Liew, 2012; McClelland & Cameron, 2012; Ursache et al., 2012). Although there is increasing empirical evidence of the shared biological, psychological and behavioural processes underlying both emotion and cognitive regulation (Berkman et al., 2012; Espy et al., 2011; Posner, Rothbart, Sheese & Tang, 2007), the role that environmental influences play in shaping development across these respective domains remains poorly understood. Research in normative development has demonstrated that emotion and cognitive regulation are shaped partly by the parent-child relationship. Therefore, it is important to understand the relative contributions of the family environment to emotion and cognitive regulation in at-risk populations of children (Morris et al., 2007; Fay-Stammbach, Hawes, Meredith, 2014).

Childhood maltreatment—which includes neglect, physical, sexual or emotional abuse—is one of the most well-established risk factors for development, which appears to have a substantial environmentally mediated effect on psychopathology (Rutter, 2012).

According to Cole, Michel and Teti (1994), adverse caregiving characterised by insensitive, unpredictable and threatening interpersonal exchanges results in children's decreased sense of emotional security, which can overwhelm an individual's self-regulatory abilities, resulting in deregulation. Due to the separation of studies on the respective emotional and cognitive sequelae of child maltreatment (Cicchetti, 2012), it remains unknown whether maltreatment exerts overlapping or independent influences on child emotion and cognitive regulation. Generally, studies of child maltreatment have focused on cognitive domains of development (e.g., IQ or executive function), and have been concerned largely with school or academic outcomes (Jaffee & Maikovich-Fong, 2011; Manly, Lynch, Oshri, Herzog & Wortel, 2013), whereas studies concerned more with emotion-based deficits (e.g., emotion regulation) have focused on behavioural outcomes (Davies, Sturge-Apple, Cicchetti, Manning & Zale, 2009; Kim & Cicchetti, 2010). Few studies have examined emotion and cognitive regulation concurrently in the same sample of maltreated preschoolers.

6.1 Relationships Between Emotion and Cognitive Regulation

Self-regulation refers to the processes for regulating behavioural, emotional and attentional impulses (Duckworth, 2011). There are diverse opinions regarding the construct of self-regulation; however, two accepted frameworks include emotion and cognitive regulation (Liew, 2012). Emotion regulation is defined in this study as the internal and external processes involved in initiating, maintaining and modulating the occurrence, intensity and expression of emotions (Eisenberg & Spinrad, 2004; Thompson, 1994). This definition highlights the external familial influences on children's modulation of emotions (Morris et al., 2007) and also encompasses emotional or temperamental reactivity known as effortful control (Rothbart & Bates, 2006). Cognitive regulation has been referred to by numerous other terms, including executive function, executive or cognitive control. In this thesis, cognitive regulation is utilised to refer to the cognitive-based regulation of thought and

action needed for future-oriented and purposeful behaviour (Zelazo, Carter, Reznick & Frye, 1997). Cognitive regulation involves the flexible selection and suppression of information for ensuing working memory, planning and organisational abilities (Carlson & Wang, 2007). Although the domains of emotion and cognitive regulation are widely studied, there is little consensus on how they should be operationalised and measured (Blankson et al., 2013; Cole, Martin & Dennis, 2004; Isquith et al., 2004). As a result, there are currently no validated instruments that assess pure emotion versus cognitive regulation in young children (Anderson & Reidy, 2012).

Due to the similarities between emotion and cognitive regulation, there has been a paradigmatic shift to an integrated perspective of self-regulation in which emotion and cognitive regulation are viewed as closely interrelated (Bell & Wolfe, 2007; Liew, 2012). One particular model proposes that environmentally mediated disruptions in one domain of control may have reciprocal influences on the other (Ursache et al., 2012). According to this bidirectional model of self-regulation, adverse experiences such as maltreatment may trigger bottom-up (amygdala driven) biological stress responses in attention, emotion and stress arousal, which in turn hinder the use of top-down (prefrontal cortex driven) volitional cognitive regulation abilities in the service of goal-directed actions (McCrory et al., 2010; Ursache et al., 2012). Ursache et al. (2012) suggest that an optimal balance within this model is achieved through the provision of supportive caregiving or a structured classroom or other environmental factors that facilitate the child's cognitive regulation for goal-directed tasks in problem-solving, planning, working memory or organisation.

6.1.1 Self-regulation in Maltreated Children

Development of self-regulatory behaviours are thought to emerge largely within the family context (Morris et al., 2007), consequently disruptions in the early caregiving environment in the form of neglect, emotional, physical or sexual maltreatment are likely to

have negative effects on emotion and cognitive regulation (Pears et al., 2010). Childhood maltreatment has been linked to cognitive self-regulatory problems in both school-aged children and to a lesser extent in younger children. Substantial evidence for an association between maltreatment and deficits in cognitive regulation comes from post-institutionalisation studies of school-aged children, who were found to have inadequate working memory (Bos et al., 2009), inhibitory control (Pollak et al., 2010) and planning (Bauer, Hanson, Pierson, Davidson & Pollak, 2009). Studies of post-institutionalised preschoolers have reported mixed findings with respect to cognitive regulation problems, possibly due to methodological differences between studies (e.g., Jacobs et al., 2010; Merz & McCall, 2011). However, one noteworthy study of post-institutionalised toddlers found that although cognitive regulation (indexed by performance-based measures) was positively related to the quality of care in the institution, the time spent with their biological parents prior to institutionalisation had an enduring protective effect on cognitive regulation. In addition, there is mounting evidence from studies of maltreated foster children that experiences of maltreatment are related to cognitive regulation difficulties in cognitive flexibility, inhibitory control, attention, working memory and planning (for a review, see DeGregorio & McLean, 2013). Although research underscores the extent of cognitive regulation problems in adopted post-institutionalised and maltreated foster children, little is currently known about cognitive regulation in preschoolers at lower risk of maltreatment, who are still residing with their biological parents.

With respect to emotion regulation, considerable research over the past decades supports the negative effects that maltreatment has on child emotion regulation, particularly in perceiving, processing and interpreting emotion stimuli (e.g., Curtis & Cicchetti, 2011; Pollak et al., 2010; Wilbarger, Gunnar, Schneider & Pollak, 2010). In addition, evidence supports that notion that maltreated compared to non-maltreated children display more

emotional ability, less adaptive regulatory strategies (Shields & Cicchetti, 1998) and inappropriate emotion expression, including higher rates of fearfulness, anger, aggression and sadness (Maughan & Cicchetti, 2002; Shipman & Zeman, 2001). The search for protective factors that promote emotion regulation in children facing adversity is important, as research on maltreated school-aged children suggests that the moderate control of emotion increases resilience and prevents maladaptive outcomes (Cicchetti, 2012).

These findings provide strong support for the independent associations between maltreatment and emotion and cognitive regulation, respectively; however, in the absence of studies that have examined these aspects of self-regulation concurrently in the same sample of maltreated preschoolers, it remains uncertain whether child emotion and cognitive regulation are similarly affected by maltreatment.

6.1.2 Parenting Practices and Self-Regulation

While adverse caregiving has been negatively associated with children's emotion and cognitive regulation, contrasting evidence suggests that high-quality caregiving fosters children's self-regulation (Morris et al., 2007). Through actions or behaviours directed towards their children, parents provide daily opportunities that guide the development of children's emotional, cognitive and self-regulatory skills (Gauvain, 2001). In a recent review of normative early childhood studies, child cognitive regulation was found to be statistically associated with the parenting dimensions of: 1) scaffolding, 2) stimulation, 3) sensitivity/responsiveness versus hostility/rejection, and 4) control (Fay-Stammbach et al., 2014; Karreman et al., 2006). Further, research suggests that the relationship between parenting and child cognitive regulation is dynamic, changing over time and involving bidirectional as well as unidirectional effects (e.g., parent-mediated effects on children) (Blair, Raver, Berry & Family Life Project, 2014). Related studies from the temperament field have examined the contributions of parenting on child emotion regulation. For example, early caregiving

influences—including parental responsiveness (Kochanska et al., 2000), maternal warmth (Spinrad et al., 2007) and parental discipline (Olson et al., 2011)—have been associated with individual differences in child effortful control. Together, these studies demonstrate that early parent-child interactions involving sensitivity/warmth, scaffolding, stimulation and support are associated with the development of emotion and cognitive regulation in children.

Nonetheless, these findings pertain mostly to more global aspects of parenting that have been studied in samples of predominantly middle-class, low-risk families (Grusec & Davidov, 2010). Hence, further work is required to investigate parenting behaviours that are specifically related to the development of self-regulatory behaviours among at-risk preschoolers referred to child protection or early intervention programs (AIFS, 2012).

ERSBs refer to specific actions (e.g., emotion encouragement or comforting), reactions (e.g., emotion-focused reactions) or strategies (e.g., cognitive re-framing) that help modulate a child's distress for the goal of adaptive emotion control (Morris et al., 2007). Generally, research with typically developing children has demonstrated that parents' self-reported reactions to children's emotions—including acceptance of emotional displays, discourse about emotions and supportive strategies—are related to higher levels of child emotion regulation and socio-emotional competence (e.g., Eisenberg et al., 1998; Spinrad, Stifter, Donelan McCall & Turner, 2004). Conversely, when mothers respond in unsupportive ways to their child's distress, by ignoring or minimising responses, they heighten their child's emotional arousal and teach avoidant rather than constructive strategies for regulating emotions (e.g., Eisenberg & Fabes, 1994; Eisenberg et al., 1999; Synder, Stoolmiller, Wilson & Yamamoto, 2003). Overall, these theoretical and empirical findings support the link between ERSBs and emotion regulation, and reflect the rise in innovative parenting programs that target emotion-communication, awareness or coaching strategies (e.g., Gottman, Katz & Hoover, 1997; Havighurst et al., 2013).

6.1.3 Maltreatment, Emotion-Related Parenting Behaviours and Children's Self-Regulation

Given the negative emotional tone of home environments in which maltreated children are raised, it follows that maltreating parents would exhibit less supportive responses to children's emotional displays (Shipman & Zeman, 2001). Two multi-method studies conducted with physically abused school-aged children found that ERSBs mediated the relationship between child maltreatment and child emotion regulation (lability/negativity) (Shipman et al., 2007; Shipman & Zeman, 2001). Parents of maltreated children displayed less understanding and validation of children's emotional displays, as well as less effective co-regulating strategies (Shipman et al., 2007; Shipman & Zeman, 2001). A third study conducted on maltreated and non-maltreated toddlers found that parents' ERSBs (specifically, expression of positive and negative affect) were associated with child emotion regulation (observed effect intensity and effortful control) across all children; however, only in the maltreated group was parental negative affect related to emotion control problems (Robinson et al., 2009). Though these studies captured variability in ERSBs across maltreating families and demonstrated that emotion regulation is a link between parenting and child adjustment, they did not examine cognitive regulation in addition to emotion regulation. Another limitation was that few studies considered other contextual factors that may have confounded the effects of maltreatment and parenting quality on child self-regulation.

Determining the unique effects of maltreatment on children's self-regulatory problems is challenging, because maltreated children often reside with families characterised by other multiple psychosocial risk factors, such as interparental conflict (Maughan & Cicchetti, 2002) or low incomes (Evans & Kim, 2013). Thus, the observed effects of maltreatment could reflect the influence of these other risk factors for children's self-

regulation. For example, low SES in early childhood has been identified as a robust predictor of concurrent and later executive function (e.g., Hackman et al., 2010; Raver, McCoy, Lowenstein & Pess, 2013). Likewise, parental depression has been shown to undermine supportive parenting and subsequent self-regulation in young children (Hughes et al., 2013). In addition, individual child factors (e.g., verbal language, cultural background and bilingualism) may confound the relationship between maltreatment and emotion and cognitive regulation (Fuhs & Day, 2011; Hackman et al., 2010; Poulin-Dubois, Blaye, Coutya & Bialystok, 2011; Rhoades et al., 2011). It should be noted that little research to date has considered the interplay among all these contextual factors, maltreatment and ERSBs on maltreated children's self-regulation.

Further, few studies have examined whether ERSBs moderate the risk of maltreatment to child emotion regulation or cognitive regulation. One noteworthy longitudinal study of maltreated preschoolers found that sensitive (self-reported) parenting provided a protective-stabilising factor, such that children with high positive parenting were not affected by the risk condition of low self-regulation (parent reported) (Kim-Spoon et al., 2012). Interestingly, abusive parents displayed a variable range of expressed sensitivity rather than an assumed absence of positive behaviour (Kim-Spoon et al., 2012). Given that warm family relationships and responsive caregiving promote children's adaptive function both in the presence and absence of adversity (Rutter, 2012), it is important to investigate the role of ERSBs in samples of maltreated preschoolers. More empirical evidence regarding the associations between distinct forms of ERSBs and distinct domains of self-regulation may address the current lack of parent-and-child-focused interventions for maltreated children.

6.2 Study 3

Despite emergent research that supports shared biological and psychological processes between emotion and cognitive regulation (e.g., Berkman et al., 2012), there is far

less evidence that explains the environmental influences that are common to their development (Calkins & Marcovitch, 2010). Although there has been a growth in identifying caregiving risk factors associated with emotion and cognitive self-regulatory problems in children, the literature on maltreatment has examined child emotion regulation separate to cognitive regulation. Accordingly, Study 3 sought to examine whether child maltreatment risk levels has common effects on both children's emotion and cognitive regulation. Further, the current study sought to increase understanding of the interactions of ESRBs on specific domains of self-regulation in maltreated children, given that emotion-coaching skills are a potential target for parenting interventions. Finally, the current study addressed limitations of prior research and accounted for correlated risk factors (e.g., parental depression, ethnicity and SES, child verbal language) in order to parse out the unique effects of maltreatment on children's self-regulation.

The major aim of Study 3 was to investigate whether risk of child maltreatment would have common or distinct relationships with preschoolers' emotion and cognitive regulation, as indexed by a caregiver rating scale of self-regulation. In accordance with integrative models of self-regulation, which posit that emotion and cognitive regulation processes are interrelated, it was hypothesised that maltreatment risk would be associated with both emotion and cognitive regulation (e.g., Calkins & Marcovitch, 2010; Ursache et al., 2012). The second hypothesis of the study was to test whether ERSBs would moderate the associations between maltreatment risk and emotion and cognitive regulation, respectively. It was hypothesised that positive dimensions of ERSBs (problem-focused, emotion-focused, expressive encouragement) would mitigate the effects of maltreatment risk on child self-regulation, and that negative ERSBs (punitive, minimising reactions) would amplify the risk of maltreatment to child self-regulation. Given existing evidence that ERSBs are robustly associated with emotion regulation in typically developing children (Eisenberg et al., 1998),

it was further predicted that such moderator effects associated with ERSBs would be particularly apparent for emotion regulation relative to cognitive regulation.

6.3 Method

6.3.1 Participants

For the present analysis, all children recruited from the three different cohorts were grouped into a single sample. Participants ($N = 107$) were preschool boys ($n = 65$) and girls ($n = 42$) aged 4 and 5 years ($M = 4.75$, $SD = 0.57$), and their mother ($n = 95$) or father ($n = 12$). The demographic characteristics and maltreatment classifications of the 107 parent-child dyads are summarised in Table 3.1. Refer to Chapter 3 for details on the sample and recruitment.

6.3.2 Measures

For this analysis, categorisation of children's maltreatment type/count (multiplicity) and child verbal language (PPVT-III) were assessed using the methods described in Chapter 3. In addition, parents' self-reported ERSBs (CCNES) and depression (DASS) were assessed using the methods described in Chapter 3. For the purposes of this study, the DVs of emotion and cognitive regulation were indexed by different clinical scales of a widely used indicator of preschoolers' self-regulation, the BRIEF-P (Gioia et al., 2003). Specifically, the Inhibit, Shift and Emotional Control scales were used to measure emotion regulation or more affective aspects of self-regulation. The metacognitive scales of Working Memory and Organise/Plan were used as the measure of cognitive regulation for more cognitive aspects of self-regulation. Prior research has differentiated the Inhibit and Emotional Control scales as the scales that most tap into affective dimensions (Sherman & Brooks, 2010). Specifically, a prior study used the Emotional Control scale in combination with other emotion regulation measures as a measure of emotion regulation (Liebermann et al., 2007). Additionally, the Inhibit, Shift and Emotional Control scales have been used to index behavioural

characteristics of temperamental facets of effortful control (Kim-Spoon et al., 2012). Further details of the BRIEF-P and other measures used in this analysis are found in Chapter 3.

6.3.3 Procedure

The child was administered a verbal language test (PPVT—III) while the caregiver completed a brief demographic questionnaire and a caregiver rating scale of self-regulation. The researcher administered, collated and scored the language test and caregiver questionnaire and self-regulation rating scales (BRIEF-P). Immediately following the session, the child was given a set of decorative stickers. Caregivers received a written report summarising the child's test performance and parent responses on the standardised measures.

6.3.4 Data Analytic Plan

Preliminary analyses were conducted to examine patterns of normality and missing data. The parenting variables (DASS, CNNES) and child variables (BRIEF-P) were significantly skewed and were log transformed. As there were no missing data for the executive function measures and other variables, it was not necessary to use estimation techniques. Next, tests of bivariate correlations were conducted to identify the covariates of child emotion regulation. This was done by examining correlations between the theoretically derived covariates of child age, ethnicity (Indigenous), child verbal language, child bilingualism, maternal education and parental depression with the DVs. Linear regression analyses were conducted to examine the independent contributions of predictor variables and interactions between parenting and maltreatment on child self-regulation. To examine the unique and interactive contributions of maltreatment and parenting to emotion and cognitive regulation, a series of linear regression models were used. A separate hierarchical regression was performed for each of the five DVs of the BRIEF-P clinical scales (Inhibit, Shift, Emotional Control, Working Memory and Plan/Organise scales) with all five subscales (problem-focused, emotion-focused, expressive encouragement, punitive and minimisation)

of the independent parenting variable (CCNES) included within the same analysis. In each of these regressions, one of the five BRIEF-P scales was the DV, with independent variables tested in three blocks. Block 1 consisted of six covariates, including four child covariates (age, ethnicity, verbal language and bilingualism) and two parent covariates (parental education and depression). Block 2 consisted of maltreatment risk and each of the five parenting domains (problem-focused, emotion-focused, expressive encouragement, punitive and minimising reactions). Block 3 included the two way interactions between maltreatment and each of these variables (maltreatment x problem/emotion/expressive encouragement/punitive/minimisation) to test parenting as a potential moderator of the caregiver ratings scales of executive function (BRIEF-P clinical scales of Inhibit, Shift, Emotional Control, Working Memory, Plan/Organise).

As recommended for testing interaction terms in regression, all predictor variables were first centred (Aiken & West, 1991). The VIF (Velleman, 1981) was also calculated for each model to monitor the effects of multicollinearity. Significant interaction terms were probed post-hoc using the established method of simple slope analysis outlined by Aiken and West (1991), which is recommended for interpreting moderating effects in child and family research (Holmbeck, 2002). Using this method, conditional moderator variables corresponding to + 1 *SD* from the centred value for each participant were computed to test the significance of the respective independent variable at high and low levels of the moderator variable.

6.4 Results

Descriptive statistics and correlations among the key variables measured are presented in Table 6.1. As expected, there were significant intercorrelations among the five BRIEF-P scales contained within this measure, ranging from $r = .37$ to $r = .83$, all $p < .01$. Each of the child covariates of age, ethnicity, verbal language and bilingualism were weakly significantly

correlated with one to two BRIEF-P scales, ranging from $r = -.19, p < .05$ to $r = -.27, p < .01$. Lower levels of maternal education were correlated with increased Plan/Organise problem scores (higher score reflects lower ability), while parental depression was weakly significantly correlated with the Shift scale ($r = -.21, p < .05$) and Emotional Control ($r = -.26, p < .01$). Child gender was not associated with BRIEF-P, thus was not used in the main analyses. As all correlations between predictor and outcome variables were weak to moderate, multicollinearity was not breached (see Tabachnick & Fidell, 2007).

Table 6.1

Descriptive Statistics and Correlations Among Key Variables and Self-Regulation

	1	2	3	4	5	6	7	8	9	10	11
1. Child age	1										
2. Child verbal language	.01	1									
3. Maternal education	.00	.11	1								
4. Child ethnicity (Indigenous)	-.15	-.06	-.31**	1							
5. Child bilingualism	-.11	-.34**	.23*	-.14	1						
6. Parental depression	.02	.05	-.23*	.02	-.01	1					
7. BRIEF-P Inhibit	-.19*	.02	-.09	.08	-.15	.19	1				
8. BRIEF-P Shift	-.20*	-.12	.05	-.08	.13	.21*	.34**	1			
9. BRIEF-P Emotional Control	-.10	.13	-.14	-.01	.22*	.26**	.71**	.50**	1		
10. BRIEF-P Working Memory	-.21*	-.23*	-.16	.22*	-.14	.10	.67**	.42**	.49**	1	
11. BRIEF-P Plan/Organise	-.12	-.18*	-.26**	.24*	.01	.17	.67**	.37**	.51**	.82**	1
<i>M</i>	57	107.50	12.9	1.08	1.20	6.86	27.72	15.55	16.98	26.71	16.65
<i>SD</i>	6.8	13.67	1.57	.28	.39	7.85	6.94	4.10	4.14	6.59	4.09

Note. * $p < .05$; ** $p < .01$

6.4.1.1 Hypothesis 1: Association Between Maltreatment, Emotion Regulation and Cognitive Self-regulation

Regression statistics for the full model are reported in Table 6.2. This hypothesis was supported by significant associations between maltreatment risk and measures that tapped emotion regulation (Inhibition, Emotional Control scales) as well as between maltreatment risk and measures that tapped cognitive regulation (Working Memory and Plan/Organise scales). The positive coefficient indicated that lower performance (indicated by higher scores) on Inhibition, Emotional Control, Working Memory and Plan/Organise scales occurred with higher or multiple maltreatment types. Maltreatment predicted scores on the scales of Emotional Control ($\beta = .26$, $SE = .05$, $p < .05$), Inhibit ($\beta = .32$, $SE = .05$, $p < .01$) and the cognitive scales of Working Memory ($\beta = .24$, $SE = .04$, $p < .05$) and Plan/Organise ($\beta = .25$, $SE = .05$, $p < .05$). Surprisingly, scores on the Shift scale, which taps affective/adaptive domains, was not associated with maltreatment.

6.4.1.2 Hypothesis 2: Prediction of Emotion and Cognitive Regulation by Maltreatment x Emotion-Related Parenting Behaviours

This hypothesis was supported by positive significant interaction effects of ERSBs operating differently at high- and low-risk conditions for the two BRIEF-P clinical scales of Shift and Emotional Control, which tap emotion regulation. There were no interaction effects of ERSBs with the clinical scales of Working Memory and Plan/Organise (measure of cognitive regulation), nor with the Inhibit scale (measure of emotion regulation).

Table 6.2

Test of Maltreatment and Parenting as a Moderator of the Associations Between Maltreatment and Emotion and Cognitive Regulation

	Inhibit		Shift		Emotion Control		Working Memory		Plan/Organise	
	<i>SE</i>	β	<i>SE</i>	β	<i>SE</i>	β	<i>SE</i>	β	<i>SE</i>	β
<i>Step 1</i>										
Child age	.00	-.17	.00	-.20*	.00	-.12	.00	-.10	.00	-.02
Child ethnicity (Indigenous)	.10	-.05	.10	-.17	.10	-.14	.09	.12	.10	.11
Child bilingualism	.07	-.13	.07	.07	.07	-.14	.07	.11	.07	.03
Child verbal language	.20	.02	.21	-.17	.20	.07	.19	-.18	.20	-.17
Maternal education	.02	-.08	.02	.06	.02	-.13	.02	-.09	.02	-.15
Parental depression	.02	.11	.02	.29**	.02	.23*	.02	.02	.02	.11
<i>Step 2</i>										
Maltreatment (Count)	.05	.32**	.05	.05	.05	.26*	.04	.24*	.05	.25*
Problem-focused	.30	-.11	.32	.16	.30	.19	.28	-.09	.30	.05
Expressive encouragement	.14	-.07	.15	-.05	.14	-.03	.13	-.15	.14	-.10
Emotion-focused	.56	.25	.28	-.02	.26	.06	.24	.17	.26	-.09
Minimisation	.10	.04	.11	-.10	.10	.08	.09	.05	.10	.05
Punitive	.11	.15	.12	.17	.11	.00	.11	.22	.11	.14
<i>Step 3</i>										
Maltreatment x problem-focused	.60	.10	.65	.31*	.61	.16	.57	.18	.60	.30*
Maltreatment x expressive encouragement	.24	.16	.26	-.08	.24	.10	.23	.00	.24	-.20
Maltreatment x emotion-focused	.57	-.25	.62	-.38*	.58	-.30*	.55	-.12	.57	-.22
Maltreatment x minimisation	.19	.01	.21	.17	.19	.12	.18	.09	.19	.14
Maltreatment x punitive	.22	-.04	.23	-.07	.22	.01	.21	-.06	.22	-.14

Note. * $p < .05$. ** $p < .01$.

As expected, the Shift dimension, which taps the ability to change plans according to social expectations, was predicted by both main effects of child age ($\beta = -.20$, $SE = .00$, $p < .05$) and parental depression ($\beta = .29$, $SE = .02$, $p < .01$), as well as the interaction terms for maltreatment x problem-focused reactions ($\beta = .31$, $SE = .65$, $p < .05$) and maltreatment x emotion-focused reactions ($\beta = -.38$, $SE = .62$, $p < .05$). Thus, consistent with the prediction, parents with lower levels of problem-focused and emotion-focused reactions had children with poor ability in cognitive flexibility/shifting. Simple slope analysis of these interactions indicated that maltreatment risk was significantly associated with the Shift scale at low levels of emotion-focused reactions ($\beta = .32$, $SE = .08$, $p < .05$), but not at high levels of emotion-focused reactions ($\beta = -.17$, $SE = .07$, $p = .25$). Thus, children of parents reporting more emotion-focused reactions appeared to be protected from risk of maltreatment for the Shift scale, whereas children of parents reporting less emotion-focused reactions were vulnerable. The interaction term for maltreatment risk x problem-focused reactions was not found to be robust to simple slope analysis (e.g., maltreatment was not differentially associated with the Shift scale at either high or low levels of problem-focused reactions when tested without other interaction terms in the model). The notion that problem-focused reactions moderated the association between maltreatment and the Shift scale was therefore not supported.

The Emotional Control scale was predicted by parental depression ($\beta = .23$, $SE = .02$, $p < .05$) and maltreatment risk ($\beta = .26$, $SE = .05$, $p < .05$), as well as the interaction term of maltreatment x emotion-focused reactions ($\beta = -.30$, $SE = .58$, $p < .05$). Simple slope analysis of this interaction indicated that maltreatment risk was significantly associated with the Emotional Control scale at low levels of emotion-focused reactions ($\beta = .47$, $SE = .07$, $p < .01$), but not at high levels of ($\beta = .04$, $SE = .07$, $p = .76$). Thus, higher levels of emotion-focused reactions appeared to protect against the risks that maltreatment confers on child emotion regulation.

Though the Plan/Organise scale was also predicted by an interaction effect for maltreatment risk x problem-focused ($\beta = .30$, $SE = .60$, $p < .05$), the interaction term was not found to be robust to simple slope analysis (e.g., maltreatment was not differentially associated with Plan/Organise at either high or low levels of problem-focused reactions when tested without other interaction terms in the model). The notion that problem-focused reactions moderated the association between maltreatment and Plan/Organise scale was therefore not supported. Neither working memory nor Plan/Organise scales were associated with parental depression.

6.5 Discussion

Study 3 investigated whether child maltreatment would have common or distinct relationships with preschoolers' emotion regulation versus cognitive regulation, as indexed by a caregiver rating scale. In addition, the study explored whether ERSBs moderate associations between maltreatment risk and each of these respective self-regulatory domains. This study was guided by a recent integrated model of self-regulation, which proposed that emotion and cognitive regulation are interrelated through common environmental influences, including maltreatment and parenting behaviours (Ursache et al., 2012). Although there is increasing support for the common neural and psychological processes across these constructs of self-regulation (Nigg, 2000; Posner et al., 2007), little empirical evidence of their common environmental processes exists (Calkins & Marcovitch, 2010). The findings of Study 3 extend this literature and demonstrate that emotion and cognitive regulation were both associated with maltreatment risk and that ERSBs (emotion-focused reactions) moderated the relationship between maltreatment and child emotion regulation.

Maltreatment was associated with all BRIEF-P clinical scales (except for the Shift scale), which supported Study 3's hypothesis that maltreatment would exert common rather than distinct environmental influences on emotion and cognitive regulation in children during

early childhood. Thus, Study 3's findings extended prior research that had focused largely on independent studies of executive function and emotion control in maltreated children. These data support the view from the field of developmental psychopathology that maltreatment results in a child's chronic inability to modulate emotional, cognitive and behavioural responses (Cicchetti, 2012). These findings extend prior evidence that emotion and cognitive regulation are related through common prefrontal neural networks (for a review, see Berkman et al., 2012) and psychological processes of attention and inhibitory control (Nigg, 2000; Posner et al., 2007).

The lack of an association between maltreatment and the BRIEF-P Shift scale was unexpected, particularly given prior findings from factor analytic data that this scale taps more affective dimensions of control (Denckla, 2002; Sherman & Brooks, 2010). The Shift scale is indexed by the ability to shift from one activity, adapt to changed routines or flexible problem solving (Gioia et al., 2003). Often referred to as cognitive flexibility or attentional shifting, executive function researchers consider this a slower developing core component of executive function (Diamond, 2013; Garon et al., 2008). Hence, it is possible that items within this scale tap abilities that were not viewed by caregivers as problematic for this young age group (Diamond, 2013).

As expected, the associations between maltreatment and Emotional Control and Shift scales were moderated by ERSBs (emotion-focused reactions), whereas no moderation effects were found for the BRIEF-P scales, which tap more cognitive aspects of self-regulation. It may follow that because the Shift and Emotional Control scales tap affective or mood-related situations, they are more proximal to ERSBs that guide and constrain these abilities in young children (Gioia et al., 2003; Liebermann et al., 2007). This finding provides novel, preliminary research and suggests that parents who use more emotion-focused supportive strategies may help buffer the risk of maltreatment to child emotion regulation. In

line with resilience research, it appears that higher-quality parenting in the context of adverse environments may exert a significant protective effect during the early childhood years (Kim-Spoon et al., 2012; Obradovic, 2010). Further, this finding has highlighted that negative outcomes from maltreatment are not inevitable and that ERSBs may ‘protect’ against the progression of regulatory problems and future maladaptive pathways (Luthar & Cicchetti, 2000).

Surprisingly, neither parents’ positive reactions of expressive encouragement nor negative reactions that were minimising or punitive were associated with emotional or cognitive aspects of child self-regulation. Only emotion-focused and problem-focused parental reactions were associated with emotional aspects of self-regulation. A lack of association between these negative parenting behaviours and maltreatment may be attributed to reporter bias, in that caregivers, especially those known to child protection services, may be reluctant to rate these scales truthfully (Healey & Fisher, 2011). This finding could also reflect the possibility that real-world parenting involves combinations of both positive and negative dimensions and that the balance between them may have an effect on overall parenting quality. This phenomenon was illustrated by a previous normative study, in which emotion coaching had no effect on children’s emotional outcomes, but interacted with emotionally dismissive parenting such that it protected children from the detrimental effects of dismissive parenting (Lunkenheimer et al., 2007). Finally, it was interesting to note that parental depression was associated with child emotion regulation (indexed by the Emotional Control and Shift scales) but not cognitive regulation (indexed by the Working Memory and Plan/Organise scales). This finding supported previous research that found links between maternal depression and effortful control (Choe et al., 2013), but contrasted with a recent study’s findings that emotion regulation (indexed by tasks that tapped inhibitory control, working memory and planning) was associated with maternal depression throughout the early

childhood years (Hughes et al., 2013). This discrepancy may reflect the different methodologies in executive function assessment, as the latter study used performance measures that may have been more sensitive or specific to detecting individual emotion regulation components in comparison to caregiver rating scales of self-regulation. Overall, Study 3's findings provide preliminary support for the common adverse effects of maltreatment on emotion and cognitive regulation and the specific moderating influence of parental emotion socialisation on child emotion regulation.

6.6 Limitations and Future Directions

There are several limitations to Study 3 that warrant discussion. Although the study found unique effects of maltreatment on emotion and cognitive regulation while controlling for an array of child and family covariates, it was not possible to determine how much of the effects were accounted for by other established risk factors of substance abuse, domestic violence or neighbourhood quality. Additionally, this cross-sectional study relied on a single-parent informant across the measures of parenting, parental depression and child self-regulation, which in comparison to multi-informant study designs poses potential risk of reporter bias (social desirability, parental psychopathology) (Cummings, Davies & Campbell, 2000). Nonetheless, the use of a single measure (BRIEF-P) for tapping cognitive versus affective dimensions of control may have reduced method invariance. As this study was cross-sectional, it was constrained by a unidirectional model of parent-mediated effects on early childhood regulation. Recent research has emphasised the bidirectional relationships between parenting and child executive function abilities and the importance of incorporating 'cascade' developmental models for observing reciprocal pathways of influence (Blair et al., 2014). It cannot be assumed that the relationship between maltreatment and child self-regulation is a static one in early childhood, given the notion that parenting practices change over time as a function of other child, family and environmental factors (see Blair et al.,

2014). As such, it will be important for future studies to incorporate longitudinal designs for examining potential transactional relationships among maltreatment, contextual risk factors, parenting and child self-regulation (Yates et al., 2010).

Strengths of Study 3 related to the well-delineated maltreatment types, the inclusion of a comparison group of non-maltreated children, and the use of multiple child and family covariates. Given the demands associated with research involving maltreated children, studies have often been conducted solely on school-aged children, without participation from caregivers. Thus, a specific strength of Study 3 was the inclusion of young at-risk children and their parents.

The findings of Study 3 have important implications for early intervention and maltreatment prevention models. Currently, there are no child-focused programs that target self-regulatory problems in at-risk children (Parenting Research Centre, 2013). Given that the findings suggest that maltreatment has a negative impact on both emotional and cognitive aspects of self-regulation, it may be feasible to assess broad rather than specific domains of self-regulation in young at-risk children. In light of the limited availability of standardised measures of cognitive regulation for young children (Anderson & Reidy, 2012), it would be appropriate to use other child behaviour inventories (e.g., Eyberg Child Behaviour Inventory, Child Behaviour Questionnaire), which provide broad indicators of self-regulatory problems in this young age group.

The findings also highlight the importance of referring at-risk children to early intervention programs, particularly models that emphasise socio-emotional learning and self-regulation (Raver et al., 2011). Effective early education programs (e.g., Tools of the Mind) suitable for at-risk children provide increased opportunities for classroom-based problem solving, planning and organisation skills (Diamond & Lee, 2011). Efficacy studies provide

preliminary support that fostering child emotion regulation has a concomitant effect on cognitive regulation.

The findings of Study 3 highlight the importance of the timely provision of evidence-based parenting programs for high-risk families during the early childhood years. Parenting practices are one of the most powerful predictors of child outcomes; therefore, more resources for parenting programs that assist parents in regulating their own and their child's emotional, behavioural and cognitive regulation are required (Sanders & Mazzucchelli, 2013). The findings also highlight the need for implementing evidence-based parenting programs for maltreated children presenting with disruptive behaviour problems (e.g., Dadds & Hawes, 2006). While many established parenting programs aim to improve parental capacities for managing children's behavioural control, there are other approaches that target parents' emotion-communication skills, emotion coaching and emotional attachment (Havighurst et al., 2013; Pasalich et al., 2012). Based on the findings of Study 3, it would appear that teaching high-risk parents strategies for validating, responding and co-regulating children's distress may provide a valuable avenue for intervention. Finally, in light of new integrated models of self-regulation, further research is needed to better understand the specific domains of self-regulation that are at greatest risk in maltreated preschoolers.

6.7 Chapter Summary

This chapter presented a study which examined whether maltreatment exerts overlapping or independent influences on child emotion and cognitive regulation. Results suggested that emotion and cognitive regulation indexed by domains on a caregiver rating measure of self-regulation were both associated with maltreatment risk and that ERSBs moderated the relationship between maltreatment risk and child emotion regulation. Given that prior research has examined cognitive and emotion sequelae of maltreatment in separate studies these findings suggest that maltreatment places children's both cognitive and emotion

regulation in jeopardy and that programs which foster emotion-focused parenting may confer long term advantage for children exposed to maltreatment.

Chapter 7: General Discussion and Conclusions

The purpose of this thesis was to investigate the independent and joint effects of child maltreatment, emotion-related parenting and child/family factors on child executive function during early childhood. It is well recognised that the early life stress of maltreatment poses a considerable threat to children's physical, cognitive and socio-emotional development, particularly during sensitive periods of brain development (Pechtel & Pizzagalli, 2011). Cicchetti (2002) proposed that maltreatment disrupts the successful resolution of early milestones of development, which increases the probability of further maladaptive pathways. One important milestone of early development that is implicated in the progression of cognitive problems and psychopathology is executive function, an aspect of self-regulation subserved by the prefrontal cortex system (De Bellis et al., 2013). In line with the ecological-transactional model of human development, research suggests that maltreatment may affect the development of executive function through multiple processes, including dysregulation of neurobiological stress-response systems, disrupted family relational processes of parenting, and increased exposure to social-contextual risk factors (Cicchetti & Valentino, 2006).

Although there has been an increase in studies examining the effects of maltreatment on executive function, a number of limitations in the literature have shaped this thesis' aim. First, few studies have examined executive function in respect to family-level maltreatment, as opposed to more extreme forms of institutionalised neglect (Merz, McCall & Groza, 2013). Second, research on maltreated preschoolers has received less attention than that on school-aged children, possibly due to the challenges of evaluating executive function in younger versus older children (Anderson & Reidy, 2012). Third, executive function studies of maltreated preschoolers have rarely employed multi-method, comprehensive assessments of both performance-based and caregiver rating scales of executive function. Fourth, few

studies have differentiated the impact of maltreatment risk on child executive function from the consequences of other child (e.g., verbal language, ethnicity) and family risk factors (e.g., parental depression, SES), which often co-occur in high-risk families. Finally, very few studies of maltreated children have assessed parents' ERSBs as a potential moderator of the association between maltreatment and child executive function. This thesis was designed to address these limitations, extend research into the effects of maltreatment on executive function and contribute insights for future maltreatment prevention models.

In the following section, the collective results of the three empirical studies contained in this thesis are summarised and discussed in terms of their limitations, contributions to the literature and relevance to early intervention practice.

7.1 Principle Findings

Study 1 represents the first study to examine the profile of scores from a caregiver rating scale of executive function (BRIEF-P) in a sample of maltreated preschoolers. Relative to the non-maltreated children, the profile of scores obtained for the maltreated children was characterised by lower performance across all BRIEF-P scales/indexes and greater fluctuations between the scales. In addition, the maltreated compared to non-maltreated children had higher percentages of clinically significant indexes of executive function (i.e., scores 1.5 *SD* above the norm). Previous studies have found that maltreated foster children performed worse on research-based performance measures of executive function compared with non-maltreated children (Lewis et al., 2007; Pears et al., 2010). This thesis provides new insights because it employed a validated measure of executive function with available norm values, which enables comparisons with other populations of children. Executive function studies have begun to analyse characteristic patterns of executive function impairments across specific subgroups of children (e.g., those with ADHD and Tourettes) (Mahone et al., 2002; McCandless & O'Laughlin, 2007). Therefore, this thesis' findings provide preliminary

evidence for executive function impairments specific to maltreated children. Study 1 was also the first to compare ecologically valid rating scales of executive function with direct or performance-based measures of executive function in a unique sample of maltreated preschoolers. Findings indicated that only five of a total of 15 correlations were significant, which reflected results of a recent systematic review where only modest degrees of agreement between rating scales and performance measures were found (Toplak et al., 2013). Nonetheless, as the previous review had included studies of neurologically impaired children (McAuley et al., 2010; Toplak et al., 2013), Study 1 provided new data, specific to a younger cohort of children without neurological or medical conditions.

Despite the lack of agreement between the measurement approaches of executive function in previous studies, few researchers have sought to empirically examine the factors that mediate or moderate the association between measures. Rather, there has been a tendency for researchers to attribute more general explanations to their findings, including differences among measures' methodologies or conceptualisations of executive function (Mahone & Hoffman, 2007; Toplak et al., 2013). However, there have been suggestions that environmental or family factors may explain the differences between child executive function abilities assessed in the clinic context versus the home or school context (McAuley et al., 2010; Silver, 2000). To advance this idea, Study 1 tested whether the environmental risk factor of maltreatment risk moderated the relationship between rating scales and performance measures in a sample of preschoolers (Duncan, 2012). In partial support of previous research, the findings demonstrated that two measures (DCCS and BRIEF-P Inhibit scale) were more closely associated in the non-maltreated children, compared to the maltreated children. Thus, the present findings extend the limited research into executive function measurement in diverse samples of children by providing preliminary evidence that environmental factors

may moderate the association between rating scales and performance measures of executive function.

Despite the mounting evidence that children under the age of 6 have an increased risk of maltreatment, relatively few studies have specifically examined the early cognitive consequences of maltreatment in this vulnerable age group (DeGregorio & McLean, 2013; Lieberman et al., 2011). Study 2 provided new evidence and demonstrated that maltreatment uniquely predicted child executive function, independent of child and family covariates (e.g., parental depression, maternal education, child verbal language). The findings also contributed to a greater understanding of the negative impact of parental risk factors on child executive function (e.g., Rhoades et al., 2011). Children classified in the at-risk group who were referred for broad ranging parental risk factors (e.g., low social support, parental mental health problems) had significantly lower executive function (composite index) than the comparison children with no identified risk factors. Most importantly, the findings provided new evidence that parents' positive ERSBs operate as a protective factor in the development of executive function in maltreated preschoolers. Specifically, maltreatment was negatively associated with executive function (composite and individual executive function measures) in children whose parents reported higher levels of punitive and minimising reactions, or conversely lower levels of emotion-focused and expressive-encouraging reactions. These results consolidate evidence from normative research that parents partly shape or socialise child executive function through specific parental socialising behaviours, including reactions to children's emotions (Jones et al., 2002). In line with prior research, Study 2 found that parents who validate and support their children's emotions provide a buffering effect against the risk of maltreatment to child executive function (Kim-Spoon et al., 2012), whereas those who react harshly or critically were found to amplify the MR of executive function difficulties. Thus, contrary to the false yet widespread belief that young children are resilient

and recover from early adverse experiences (Lieberman et al., 2011), Study 2 highlights that early exposure to adversity negatively affects young children's developing executive function.

Although emerging research on integrated models of self-regulation has suggested that emotion and cognitive regulation (or executive function) operate interdependently and share common psychological, neural and behavioural processes (e.g., Berkman et al., 2012; Nigg, 2000), few studies have examined the environmental influences common to these control processes during early childhood (Calkins & Marcovitch, 2010). Study 3 addressed this limitation and found that the well-established risk of maltreatment exerted common rather than distinct environmental influences on emotion and cognitive regulation. Findings also demonstrated that parenting (ERSBs) moderated the relationship between maltreatment and child emotion regulation, but not cognitive regulation. Specifically, higher levels of emotion-focused reactions appeared to protect against the risk of maltreatment to child emotion regulation. Together, the findings from Study 3 provide preliminary evidence that emotion and cognitive regulation share commonalities at the level of environmental influences (maltreatment); however, parenting (ERSBs) may operate more proximally on child emotion regulation relative to cognitive regulation.

There were some similarities and differences in results between studies 2 and 3 that were noteworthy. Firstly, severity of maltreatment uniquely predicted both performance-based (composite of three measures) and caregiver report (emotion and cognitive regulation scales of BRIEF-P) measures of executive function. This finding that maltreatment exerts a potent influence on multiple aspects of children's self-regulation reflects previous research that has examined emotion and cognitive sequelae of maltreatment in separate studies (e.g., Kim & Cicchetti, 2010; Pears et al., 2010). Second, by examining which parenting variables moderated the negative effects of maltreatment on child self-regulation, the two studies

showed different results. In Study 2 both emotion-focused and expressive encouragement parental responses were found to protect against the negative effects of maltreatment, whereas in Study 3 only the former was found to moderate child emotion regulation. Furthermore, negative parental reactions (minimising and punitive) were found to be vulnerability factors in Study 2 whereas in Study 3 they were found to have no moderating effect on the association between maltreatment and child self-regulation. Thus, this thesis provides evidence that the risk of maltreatment does not necessarily entail a certain negative endpoint, rather proximal parenting factors have overlapping or interactive effects on child outcomes. These differences also highlight the broad construct of parenting and the importance of parsing out the relative impact of specific parenting variables on different aspects of child self-regulation. Importantly, the findings in both studies align with the developmental psychopathology view of maltreatment, that adverse caregiving results in a child's chronic inability to modulate emotional, cognitive and behavioural responses (Cicchetti, 2002; Kim-Spoon et al., 2012).

7.2 Limitations and Strengths

Several limitations in this thesis warrant cautious interpretations of the findings. First, the cross-sectional data did not allow for a determination of the directionality of effects of maltreatment and parenting on executive function. Consequently, future studies can extend this thesis' findings by testing developmental cascade models with repeated measures of parenting, maltreatment and executive function in order to differentiate their reciprocal influences (Masten & Cicchetti, 2010). Second, this thesis used caregivers as key singular informants of parental depression, parenting and child executive function, which may have contributed to reporter bias and shared method variance (Choe et al., 2013). Nevertheless, attempts were made to offset shared variance from parental reports with performance-based measures of executive function. 'Gold-standard' measures of videotaped coded observations

of parenting are considered more valid indices of parenting than self-report measures; however, given that the former method has been associated with a lower parent participation level in studies of toddler behaviours (Mence et al., 2014), it was decided that a self-report parent questionnaire was a more viable alternative for use with a high-risk sample. Although the thesis' parenting measure (CCNES) was not developed to identify clinically severe disturbances in parenting, even so the results demonstrated that parenting moderated the effects of maltreatment on executive function (Fabes, Poulin, Eisenberg & Madden-Derdich, 2002). Hence, even variations in typical caregiving behaviours confer a protective effect on executive function.

Another major challenge in child maltreatment research is differentiating the impact of maltreatment on child outcomes from other genetic, parental and social risk factors that co-occur in high-risk families (for a review of risk factors, see White et al., 2014). Although this thesis accounted for a range of child and family risk factors (e.g., ethnicity, parental depression), it did not include a separate index of domestic violence or parental drug use, which may have predicted other effects on executive function (Maughan & Cicchetti, 2002). It must be noted that the measure of child maltreatment employed in this thesis included exposure to severe domestic violence as a marker of child maltreatment; however, this measure may not have been sensitive to lower levels of interparental conflict. Previous research has shown that interparental conflict can have a spill-over effect on parenting quality and subsequent child outcomes (Maughan & Cicchetti, 2002). While this study did not investigate genetic influences on early childhood EF, evidence suggests that genetic factors play a substantial role in the emergence of individual differences (Leve et al., 2013). Future genetically informed research designs will provide opportunities to investigate the possible contribution of heritable characteristics of parents' EF, and the extent to which maltreatment has unique genetic or environmental influences.

A fourth limitation of this thesis relates to measurement issues regarding the assessment of executive function in young children (Anderson & Reidy, 2012). In this thesis, scores for each of the three performance tasks were combined to create a composite of executive function, in addition to individual scores. In previous measurement studies, structural equation modelling has been used to empirically quantify the shared, common variance across a large battery of executive function tasks for calculating a unitary, latent structure of executive function. Such models of executive function are considered more reliable and powerful measures than the approach taken in this thesis. Finally, since only 12 fathers were included in this thesis, future work should compare both maternal and paternal behaviours, particularly as recent studies suggest that parent gender is differentially associated with a range of children's outcomes (Yates et al., 2010).

Finally, in Study 2 multiple testing was conducted on a high number of 15 separate regression models due to multiple independent variables, which may have resulted in a chance significant finding. Future research should utilise methods that deal with variable selection or alternatively correct p-values with Bonferroni or step-down methods.

Despite the limitations, this thesis possesses several strengths. First, the sample included an ethnically, economically and risk-diverse sample of young children and their caregivers. It was important to sample children with varying degrees of MR, from low-risk to serious substantiated abuse. The children recruited from the early intervention program were representative of the population referred by child protection services to early intervention or family support programs. Despite allegations of harm, not all children who come to the attention of child protection workers have substantiated maltreatment; however, their exposure to family-level risk factors is considered a potential threat to their wellbeing. In contrast to previous maltreatment research, which has primarily focused on low-income, disadvantaged families, the current study sampled a relatively well-educated group of

parents. Thus, the findings confirm that maltreatment has persistent effects on executive function, irrespective of family SES, and that maltreatment occurs across broad socio-economic backgrounds (Cicchetti, 2012).

Second, consistent with the transactional-ecological approach to child development, numerous child and family factors were considered and statistically controlled in order to reduce the potential confounds for maltreatment effects (Cicchetti & Valentino, 2006). In this way, the rich data on child and caregiver characteristics provided unique insights into markers for executive function difficulties. Specifically, there were direct effects of parental depression and child ethnicity (indigenous status) on executive function, independent of maltreatment effects.

A third strength of this thesis was the use of multi-method assessments of executive function, which provided a broader evaluation of executive function across different settings. Given that the rating scales and performance measures of executive function were not consistently and strongly correlated, it appears that each measure may have provided supplementary information on possibly different aspects of executive function (Willoughby, 2013). Performance measures of child executive function contributed objective ratings to complement caregiver ratings of executive function, while the latter measure provided normative scores for observing group-based score profiles.

Fourth, this thesis considered the heterogeneity of maltreatment by examining individual differences in executive function as a function of multiplicity of maltreatment types (Kim & Cicchetti, 2010). Future research that differentiates other features of the maltreatment experience, such as age of onset, chronicity or severity, will provide further understanding of whether maltreatment experiences are differentially related to child self-regulation problems.

7.3 Implications for Practice

The findings from this thesis have important implications for early intervention. The role of early adversity on child maladjustment is beginning to be addressed in early intervention programs (Lieberman et al., 2011), and the findings presented here provide further support for intervening early. The results of this thesis point to a need for more systematic screening of executive function in preschoolers identified by child protection workers. With increasing resources directed at early intervention programs, there are more opportunities for prioritising early identification of cognitive and behaviour problems. This thesis has validated the clinical utility of executive function measures for differentiating clinically significant scores or individual differences in executive function among maltreated preschoolers. Alternately, a more broad-based measure of children's regulatory problems may be adequate for identifying early behavioural manifestations of both cognitive and emotional regulation problems. Regulatory behaviour scales and executive function performance measures are useful in discriminating specific regulatory problems from preschoolers' normative behaviours of distractibility, poor planning and impulsivity (Espy et al., 2011). Given that executive function is implicated in the development of ADHD, it is recommended that young children with histories of early trauma or maltreatment presenting with attentional problems are firstly assessed with measures of executive function before diagnostic tools for ADHD are used. A process approach to child assessment reflects a trauma-informed perspective and considers the contribution of a broad range of child, family and environmental variables which may affect the expression of abilities including the regulation of cognition, attention and emotion.

The introduction of screening methods must first be facilitated through improved child welfare policies that prioritise and streamline the coordination of education and health services for at-risk children.

Despite clear evidence that young children under 6 have a higher prevalence of maltreatment than older children, few early intervention programs specifically target early self-regulation problems in young children. This thesis highlights the need for further development of laboratory-based cognitive training or neurobiologically informed ecological interventions (Bryck & Fisher, 2012). Such programs could be incorporated into future maltreatment prevention models. For example, there is emerging evidence that ‘brain training’ using computerised exercises (e.g., working memory) or mindfulness programs are effective in improving children’s cognitive and emotional functioning (Bryck & Fisher, 2012; Tang, Yang, Leve & Harold, 2012). Other ecological, socio-emotional programs that foster child emotion regulation have been shown to be more effective for executive function and learning outcomes than standard early childhood programs (Raver et al., 2011). There is also evidence that early education programs that foster children’s problem solving, planning and autonomy are beneficial for children’s learning and self-regulation. These programs not only result in improved outcomes for children but also reduce teacher stress and improve classroom management skills (Diamond & Lee, 2011). Past research has focused on executive function programs that target preschool- or kindergarten-aged children; however, there is no reason why older maltreated children in intensive residential care facilities with disruptive behaviour disorders would not benefit from evidence-based programs that emphasise emotional and behavioural regulation (Dadds & Hawes, 2006). Given that studies of homelessness and poverty have identified executive function as an important source of resilience for children exposed to adversity (Blair, 2010; Masten et al., 2014), there is value in the future development of cognitive training and ecological interventions to improve child executive function.

The present findings also suggest that more attention be given to the assessment of supportive parenting practices when working with troubled families. This thesis’ results

indicate that positive efforts by parents to socialise their children's emotions may reduce the detrimental effects of maltreatment on the development of child executive function (Robinson et al., 2009; Shipman et al., 2007). Until recently, interventions targeting parents' emotion-communication skills were uncommon. However, there are now more innovative parenting programs suitable for high-risk families that focus on increasing parents' emotion-coaching skills, active-listening skills and emotion awareness (Gottman et al., 1997; Havighurst et al., 2013). Another recommendation for parenting programs is the provision of appropriate support for parents' psychological needs, including those related to depression, financial difficulties and past trauma. In particular, attachment-based parenting interventions assist parents to understand how their own childhood experiences may affect their capacity to respond to their child's needs. Positive findings from randomised control studies have indicated that maltreated foster care children whose caregivers have undertaken attachment-based parenting programs have more normalised stress hormone levels than children whose carers underwent standard interventions (Bernard, Butzin-Dozier, Rittenhouse & Dozier, 2010; Cicchetti et al., 2011). Such findings are aligned with the neurobiological model of stress that sensitive, responsive caregiving provides an external mechanism for moderating children's stress levels and self-regulation. This thesis recommends that other parenting programs that focus on behavioural approaches may also be suitable for high-risk families, because they coach parents to use more positive and responsive behaviours that promote children's self-regulation (Sanders & Mazzucchelli, 2013). Finally, the results in this thesis indicate a need for greater universal social prevention strategies to reduce the formidable risk of maltreatment to child executive function.

References

- AIFS. (2012). *Child abuse and neglect statistics fact sheet*. Melbourne: Australian Institute of Family Studies.
- Aiken, L. S. & West, S. G. (1991). *Multiple regression: Testing and interpreting interactions*. Newbury Park: Sage.
- Anderson, P. J. & Reidy, N. (2012). Assessing executive function in preschoolers. *Neuropsychology Review*, 22(4), 345–360. doi:10.1007/s11065-012-9220-3
- Anderson, P. J. (2002). Assessment and development of executive function (executive function) during childhood. *Child Neuropsychology*, 8(2), 71–82. doi:10.1076/chin.8.2.71.8724
- Anderson, V., Anderson, P. J., Northam, E., Jacobs, R. & Mikiewicz, O. (2002). Relationships between cognitive and behavioral measures of executive function in children with brain disease. *Child Neuropsychology*, 8(4), 231–240.
- Anderson, V., Spencer-Smith, M., Coleman, L., Anderson, P. J., Williams, J., Greenham, M., ... Jacobs, R. (2010). Children's executive functions: Are they poorer after very early brain insult. *Neuropsychologia*, 48(7), 2041–2050. doi:10.1016/j.neuropsychologia.2010.03.025
- Antony, M. M., Bieling, P. J., Cox, B. J., Enns, M. W. & Swinson, R. P. (1988). Psychometric properties of the 42-item and 21-item versions of the depression anxiety stress scales in clinical groups and a community sample. *Psychological Assessment*, 10, 176–181.
- Augusti, E. & Melinder, A. (2013). Maltreatment is associated with specific impairments in executive functions: A pilot study. *Journal of Traumatic Stress*, 26(6), 780–783. doi:10.1002/jts.21860

- Barkley, R. A. & Fischer, M. (2011). Predicting impairment in major life activities and occupational functioning in hyperactive children as adults: Self-reported executive function (executive function) deficits versus executive function tests. *Developmental Neuropsychology*, 36(2), 137–161. doi:10.1080/87565641.2010.549877
- Barnett, D., Manly, J. T. & Cicchetti, D. (1993). Defining child maltreatment: The interface between policy and research. In D. Cicchetti & S. L. Toth (Eds.), *Child abuse, child development and social policy* (pp. 7–74). Norwood, NJ: Ablex.
- Bauer, P. M., Hanson, J. L., Pierson, R. K., Davidson, R. J. & Pollak, S. D. (2009). Cerebellar volume and cognitive functioning in children who experienced early deprivation. *Biological Psychiatry*, 66(12), 1100–1106. doi:10.1016/j.biopsych.2009.06.014
- Beck, A. T., Rush, A. J., Shaw, B. F. & Emery, G. (1979). *Cognitive therapy of depression*. New York, NY: Guilford Press.
- Beers, S. R. & De Bellis, M. D. (2002). Neuropsychological function in children with maltreatment-related posttraumatic stress disorder. *American Journal of Psychiatry*, 159, 483–486.
- Bell, M. A. & Wolfe, C. D. (2007). The cognitive neuroscience of early socio-motional development. In C. A. Brownell & C. B. Kopp (Eds.), *Socio-motional development in the toddler years: Transitions and transformations* (pp. 345–369). New York, NY: Guilford Press.
- Belsky, J. & de Haan, M. (2011). Annual research review: Parenting and children's brain development: The end of the beginning. *Journal of Child Psychology and Psychiatry*, 52(4), 409–428. doi:10.1111/j.1469-7610.2010.02281.x
- Belsky, J. & Pluess, M. (2009). Beyond diathesis stress: Differential susceptibility to environmental influences. *Psychological Bulletin*, 135(6), 885–908.

- Belsky, J. (1993). Etiology of child maltreatment: A developmental-ecological analysis. *Psychological Bulletin*, 114(3), 413–434.
- Belsky, J., Fearon, R. M. P. & Bell, B. (2007). Parenting, attention and externalizing problems: Testing mediation longitudinally, repeatedly and reciprocally. *Journal of Child Psychology and Psychiatry*, 48(12), 1233–1242. doi:10.1111/j.1469–7610.2007.01807.x
- Berkman, E. T., Graham, A. M. & Fisher, P. A. (2012). Training self-control: A domain-general translational neuroscience approach. *Child Development Perspectives*, 6(4), 374–384. doi:10.1111/j.1750–8606.2012.00248.x
- Bernard, K., Butzin-Dozier, Z., Rittenhouse, J. & Dozier, M. (2010). Cortisol production patterns in young children living with birth parents vs children placed in foster care following involvement of child protection services. *Archives of Pediatrics & Adolescent Medicine*, 164(5), 438–443. doi:10.1001/archpediatrics.2010.54
- Bernier, A., Carlson, S. M. & Whipple, N. (2010). From external regulation to self-regulation: Early parenting precursors of young children’s executive functioning. *Child Development*, 81(1), 326–339.
- Bernier, A., Carlson, S. M., Deschenes, M. & Matte-Gagne, C. (2012). Social factors in the development of early executive functioning: A closer look at the caregiving environment. *Developmental Science*, 15(1), 12–24.
- Bialystok, E. (2011). Coordination of executive functions in monolingual and bilingual children. *Journal of Experimental Child Psychology*, 110(3), 461–468. doi:10.1016/j.jecp.2011.05.005
- Bialystok, E., Craik, F. I. M., Green, D. W. & Gollan, T. H. (2009). Bilingual minds. *Psychological Science in the Public Interest*, 10, 89–129.

- Bibok, M. B., Carpendale, J. I. M. & Müller, U. (2009). Parental scaffolding and the development of executive function. *New Directions for Child and Adolescent Development*, 123, 17–34. doi:10.1002/cd.233
- Bierman, K. L. & Torres, M. (in press). Promoting the development of executive functions through early education and prevention programs. In J. A. Griffin, L. S. Freund & P. McCardle (Eds.), *Executive function in preschool age children: Integrating measurement, neurodevelopment and translational research*. Washington, D.C: American Psychological Association.
- Bindman, S. W., Hindman, A. H., Bowles, R. P. & Morrison, F. J. (2013). The contributions of parental management language to executive function in preschool children. *Early Childhood Research Quarterly*, 28(3), 529–539. doi:10.1016/j.ecresq.2013.03.003
- Blair, C. & Peters, R. (2003). Physiological and neurocognitive correlates of adaptive behavior in preschool among children in Head Start. *Developmental Neuropsychology*, 24, 479–497.
- Blair, C. & Razza, R. (2007). Relating effortful control, executive function, and false belief understanding to emerging math and literacy ability in kindergarten. *Child Development*, 78(2), 647–663. doi:10.1111/j.1467–8624.2007.01019.x
- Blair, C. (2002). School readiness: Integrating cognition and emotion in a neurobiological conceptualisation of children’s functioning at school entry. *American Psychologist*, 57(2), 111–127.
- Blair, C. (2010). Stress and the development of self-regulation in context. *Child Development Perspectives*, 4(3), 181–188. doi:10.1111/j.1750–8606.2010.00145.x

- Blair, C., Granger, D. A., Willoughby, M., Mills-Koonce, R., Cox, M., Greenberg, M. T., .. Investigators., F. L. P. (2011). Salivary cortisol mediates effects of poverty and parenting on executive functions in early childhood. *Child Development*, 82(6), 1970–1984. doi:10.1111/j.1467–8624.2011.01643.x
- Blair, C., Raver, C. C., Berry, D. J. & Family Life Project, I. (2014). Two approaches to estimating the effect of parenting on the development of executive function in early childhood. *Developmental Psychology*, 50(2), 554–565.
- Blair, C., Raver, C. C., Granger, D., Mills-Koonce, R. & Hibel, L. (2011). Allostasis and allostatic load in the context of poverty in early childhood. *Development and Psychopathology*, 23(3), 845–857. doi:10.1017/S0954579411000344
- Blankson, A. N., O’Brien, M., Leerkes, E. M., Marcovitch, S. D. & Calkins, S. D. (2011). Shyness and vocabulary: The roles of executive functioning and home environmental stimulation. *Merrill-Palmer Quarterly-Journal of Developmental Psychology*, 57(2), 105–128.
- Blankson, A. N., O’Brien, M., Leerkes, E. M., Marcovitch, S., Calkins, S. D. & Weaver, J. M. (2013). Developmental dynamics of emotion and cognition processes in preschoolers. *Child Development*, 84(1), 346–360. doi:10.1111/j.1467–8624.2012.01841.x
- Bodnar, L. E., Prahme, M. C., Cutting, L. E., Denckla, M. B. & Mahone, E. M. (2007). Construct validity of parent ratings of inhibitory control. *Child Neuropsychology: A Journal of Normal and Abnormal Development in Childhood and Adolescence*, 13(4), 345–362. doi:10.1080/09297040600899867
- Bornstein, M. H., Hahn, C.-S. & Wolke, D. (2013). Systems and cascades in cognitive development and academic achievement. *Child Development*, 84(1), 154–162. doi:10.1111/j.1467–8624.2012.01849.x

- Bos, K. J., Zeanah, C. H., Fox, N., & Nelson, C. A. (2009). Effects of early psychosocial deprivation on the development of memory and executive function. *Frontiers in Behavioral Neuroscience*, 3(16), 1–7. doi:10.3389/neuro.08.016.2009
- Bradley, R. H., McKelvey, L. M. & Whiteside-Mansell, L. (2011). Does the quality of stimulation and support in the home environment moderate the effect of early education programs? *Child Development*, 82(6), 2110–2122. doi:10.1111/j.1467–8624.2011.01659.x
- Briggs-Gowan, M. J., Carter, A. S., Clark, R., Augustyn, M., McCarthy, K. J. & Ford, J. D. (2010). Exposure to potentially traumatic events in early childhood: Differential links to emergent psychopathology. *Journal of Child Psychology and Psychiatry*, 51(10), 1132–1140.
- Bronfenbrenner, U. & Morris, P. (1998). The ecology of developmental process. In R. M. Lerner & W. Damon (Eds.), *Handbook of child psychology: Theoretical models of human development* (5th ed., Vol. 1, pp. 993–1028). New York, NY: Wiley.
- Brown, E. D., Ackerman, B. P. & Moore, C. A. (2013). Family adversity and inhibitory control for economically disadvantaged children: Preschool relationships and associations with school readiness. *Journal of Family Psychology*, 27(3), 443–452.
- Bryck, R. L. & Fisher, P. A. (2012). Training the brain: Practical applications of neural plasticity from the intersection of cognitive neuroscience, developmental psychology, and prevention science. *The American Psychologist*, 67(2), 87–100.
- Bull, R. & Lee, K. (2014). Executive functioning and mathematics achievement. *Child Development Perspectives*, 8(1), 36–41. doi:10.1111/cdep.12059

- Bull, R., Espy, K. A., Wiebe, S. A., Sheffield, T. D. & Nelson, J. M. (2011). Using confirmatory factor analysis to understand executive control in preschool children: Sources of variation in emergent mathematic achievement. *Developmental Science*, 14(4), 679–692. doi:10.1111/j.1467-7687.2010.01012.x
- Calkins, S. D. & Marcovitch, S. (2010). Emotion regulation and executive functioning in early development: Mechanisms of control supporting adaptive functioning. In S. D. Calkins & M. A. Bell (Eds.), *Child development at the intersection of emotion and cognition* (pp. 37–58). Washington, DC: APA Books.
- Carlson, S. M. & Moses, L. (2001). Individual differences in inhibitory control and children's theory of mind. *Child Development*, 72(4), 1032–1053.
- Carlson, S. M. & Wang, T. S. (2007). Inhibitory control and emotion regulation in preschool children. *Cognitive Development*, 22(4), 489–510.
- Carlson, S. M. (2005). Developmentally sensitive measures of executive function in preschool children. *Developmental Neuropsychology*, 28(2), 595–616.
- Carlson, S. M., Zelazo, P. D. & Faja, S. (2013). Executive function. In P. Zelazo (Ed.), *The Oxford handbook of developmental psychology* (Vol. 1, pp. 796–743). Oxford: Oxford University Press.
- Choe, D. E., Olson, S. L. & Sameroff, A. J. (2013). Effects of early maternal distress and parenting on the development of children's self-regulation and externalizing behavior. *Development and Psychopathology*, 25(2), 437–453. doi:10.1017/S0954579412001162
- Cicchetti, D. & Toth, S. L. (1995). A developmental psychopathology perspective on child abuse and neglect. *Journal of the American Academy of Child and Adolescent Psychiatry*, 34, 541–565.

- Cicchetti, D. & Valentino, K. (2006). An ecological-transactional perspective on child maltreatment: Failure of the average expectable environment and its influence on child development. In D. Cicchetti & D. J. Cohen (Eds.), *Developmental psychopathology* (Vol. 3, 2nd ed., pp. 129–201). Hoboken, NJ: John Wiley & Sons Inc.
- Cicchetti, D. (2002). The impact of social experience on neurobiological systems: Illustration from a constructivist view of child maltreatment. *Cognitive Development*, 17, 1407–1428.
- Cicchetti, D. (2012). Annual research review: Resilient functioning in maltreated children—past, present, and future perspectives. *Journal of Child Psychology and Psychiatry*, no-no. doi:10.1111/j.1469-7610.2012.02608.x
- Cicchetti, D., Rogosch, F. A., Gunnar, M. R. & Toth, S. L. (2010). The differential impacts of early physical and sexual abuse and internalizing problems on daytime cortisol rhythm in school-aged children. *Child Development*, 81(1), 252–269. doi:10.1111/j.1467-8624.2009.01393.x
- Cicchetti, D., Rogosch, F. A., Toth, S. L. & Sturge-Apple, M. L. (2011). Normalizing the development of cortisol regulation in maltreated infants through preventive interventions. *Development and Psychopathology*, 23(3), 789–800. doi:10.1017/S0954579411000307
- Cipriano-Essel, E., Skowron, E. A., Stifter, C. A. & Teti, D. M. (2013). Heterogeneity in maltreated and non-maltreated preschool children's inhibitory control: The interplay between parenting quality and child temperament. *Infant and Child Development*, 22(5), 501–522. doi:10.1002/icd.1801

- Clark, C. A., Sheffield, T. D., Chevalier, N., Nelson, J. M., Wiebe, S. A. & Espy, K. A. (2013). Charting early trajectories of executive control with the shape school. *Developmental Psychology*, 49(8), 1481–1493.
- Cole, P. M., Martin, S. F. & Dennis, T. (2004). Emotion regulation as a scientific construct: Methodological challenges and directions for child development research. *Child Development*, 75(2), 317–333.
- Cole, P. M., Michel, M. & Teti, L. O. (1994). The development of emotion regulation and dysregulation: A clinical perspective. *Monographs of the Society for Research in Child Development*, 59(2/3), 73–100.
- Conger, R. D. & Donnellan, M. B. (2007). An interactionist perspective on the socio-economic context of human development. *Annual Review of Psychology*, 58(1), 175–199. doi:10.1146/annurev.psych.58.110405.085551
- Conway, A. & Stifter, C. A. (2012). Longitudinal antecedents of executive function in preschoolers. *Child Development*, 83(3), 1022–1036. doi:10.1111/j.1467–8624.2012.01756.x
- Cuevas, K., Deater-Deckard, K., Kim-Spoon, J., Watson, A. J., Morasch, K. C. & Bell, M. A. (2014). What's mom got to do with it? Contributions of maternal executive function and caregiving to the development of executive function across early childhood. *Developmental Science*, 17(2), 224–238. doi:10.1111/desc.12073
- Cummings, E. M., Davies, P. T. & Campbell, S. B. (2000). *Developmental psychopathology and family process*. New York, NY: Guilford Press.
- Curtis, W. J. & Cicchetti, D. (2011). Affective facial expression processing in young children who have experienced maltreatment during the first year of life: An event-related potential study. *Development and Psychopathology*, 23(02), 373–395. doi:10.1017/S0954579411000125

- Dadds, M. & Hawes, D. (2006). *Integrated family intervention for child conduct problems: A behaviour-attachment-systems intervention for parents*. Sydney: Australian Academic Press.
- Davidson, M., Amso, D., Anderson, L. C. & Diamond, A. (2006). Development of cognitive control and executive functions from 4 to 13 years: Evidence from manipulations of memory, inhibition, and task switching. *Neuropsychologia*, 44, 2037–2078.
- Davies, P. T., Sturge-Apple, M. L., Cicchetti, D., Manning, L. G. & Zale, E. (2009). Children's patterns of emotional reactivity to conflict as explanatory mechanisms in links between interpartner aggression and child physiological functioning. *Journal of Child Psychology and Psychiatry*, 50(11), 1384–1391.
- De Bellis, M. D. (2001). Developmental traumatology: The psychobiological development of maltreated children and its implications for research, treatment, and policy. *Development and Psychopathology*, 13, 539–564.
- De Bellis, M. D. (2005). The psychobiology of neglect. *Child Maltreatment*, 10(2), 150–172. doi:10.1177/1077559505275116
- De Bellis, M. D., Hooper, S. R., Spratt, E. G. & Woolley, D. P. (2009). Neuropsychological findings in childhood neglect and their relationships to pediatric PTSD. *Journal of International Neuropsychological Science*, 15(6), 868–878. doi:10.1017/S1355617709990464
- De Bellis, M. D., Woolley, D. P. & Hooper, S. R. (2013). Neuropsychological findings in pediatric maltreatment: Relationship of PTSD, dissociative symptoms, and abuse/neglect indices to neurocognitive outcomes. *Child Maltreatment*, 18(3), 171–183.
- DeGregorio, L. J. & McLean, S. (2013). The cognitive profiles of maltreated children in care and their educational needs: Supporting good outcomes. *Children Australia*, 38(01), 28–35. doi:10.1017/cha.2012.47

- Denckla, M. B. (2002). The behavior rating inventory of executive function: Commentary. *Child Neuropsychology*, 8(4), 304–306. doi:10.1076/chin.8.4.304.13512
- DePrince, A. P., Weinzierl, K. M. & Combs, M. D. (2009). Executive function performance and trauma exposure in a community sample of children. *Child Abuse & Neglect*, 33(6), 353–361. doi:10.1016/j.chiabu.2008.08.002
- Diamond, A. & Lee, K. (2011). Interventions shown to aid executive function development in children 4 to 12 years old. *Science*, 333(6045), 959–964. doi:10.1126/science.1204529
- Diamond, A. & Taylor, C. (1996). Development of an aspect of executive control: Development of the abilities to remember what I said and to do as I say, not as I do. *Developmental Psychobiology*, 29(4), 315–334.
- Diamond, A. (2013). Executive functions. *Annual Review of Psychology*, 64(1), 135–168. doi:10.1146/annurev-psych-113011-143750
- Diamond, A., Barnett, W., Thomas, J. & Munro, S. (2007). Preshool program improves cognitive control. *Science*, 318.
- Diamond, A., Carlson, S. M. & Beck, D. M. (2005). Preschool children's performance in task switching on the dimensional change card sort task: Separating the dimensions aids the ability to switch. *Developmental Neuropsychology*, 28(2), 689–729.
- Dilworth-Bart, J. E. (2012). Does executive function mediate SES and home quality associations with academic readiness? *Early Childhood Research Quarterly*, 27(3), 416–425. doi:10.1016/j.ecresq.2012.02.002

- Dirks, M. A., De Los Reyes, A., Briggs-Gowan, M., Cella, D., & Wakschlag, L. S. (2012). Annual Research Review: Embracing not erasing contextual variability in children's behavior – theory and utility in the selection and use of methods and informants in developmental psychopathology. *Journal of Child Psychology and Psychiatry*, 53(5), 558-574. doi: 10.1111/j.1469-7610.2012.02537.x
- Doan, S. N. & Evans, G. W. (2011). Maternal responsiveness moderates the relationship between allostatic load and working memory. *Development and Psychopathology*, 23(Special Issue 3), 873–880. doi:10.1017/S0954579411000368
- Dowsett, S. & Livesey, D. (2000). The development of inhibitory control in preschool children: Effects of executive skills training. *Developmental Psychobiology*, 36(2), 161–174.
- Driscoll, J. R. & Easterbrooks, M. A. (2007). Young mothers' play with their toddlers: Individual variability as a function of psychosocial factors. *Infant and Child Development*, 16 (6), 649–670.
- Duckworth, A. (2011). The significance of self-control. *Proceedings of the National Academy of Science USA*, 108(7), 2639–2640.
- Duncan, R. J. (2012). *Measures of executive function: Convergent validity and links to academic achievement in preschool* (Master of Science). Oregon State University.
- Dunn, L. M. & Dunn, L. M. (1997). *Peabody picture vocabulary test* (3rd ed.). Circle Pines, MN: American Guidance Service.
- Eisenberg, N. & Fabes, R. A. (1994). Mothers' reactions to children's negative emotions: Relationships to children's temperament and anger behavior. *Merrill-Palmer Quarterly*, 40(1), 138–156.
- Eisenberg, N. & Spinrad, T.L. (2004). Emotion-related regulation: Sharpening the definition. *Child Development*, 75, 334–339.

- Eisenberg, N., Cumberland, A. & Spinrad, T. L. (1998). Parental socialization of emotion. *Psychological Inquiry*, 9, 241–273.
- Eisenberg, N., Fabes, R. A., Shepard, S. A., Guthrie, I. K., Murphy, B. C. & Reiser, M. (1999). Parental reactions to children's negative emotions: Longitudinal relationships to quality of children's social functioning. *Child Development*, 70(2), 513–534. doi:10.1111/1467–8624.00037
- Eisenberg, N., Spinrad, T. L., Eggum, N. M., Silva, K. M., Reiser, M., Hofer, C., .. Michalik, N. (2010). Relationships among maternal socialization, effortful control, and maladjustment in early childhood. *Development and Psychopathology*, 22(3), 507–525. doi:10.1017/S0954579410000246
- Eisenberg, N., Vidmar, M., Spinrad, T. L., Eggum, N. D., Edwards, A., Gaertner, B. & Kupfer, A. (2010). Mothers' teaching strategies and child effortful control: A longitudinal study. *Developmental Psychology*, 46(5), 1294–1308. doi:10.1037/a0020236
- English, D. J., Graham, J. C., Litrownik, A. J., Everson, M. & Bangdiwala, S. I. (2005). Defining maltreatment chronicity: Are there differences in child outcomes? *Child Abuse and Neglect*, 29, 575–595.
- Espy, K. A., Sheffield, T. D., Wiebe, S. A., Clark, C. A. & Moehr, M. J. (2011). Executive control and dimensions of problem behaviors in preschool children. *Journal of Child Psychology and Psychiatry*, 52(1), 33–46. doi:10.1111/j.1469–7610.2010.02265.x
- Evans, G. W. & Kim, P. (2013). Childhood poverty, chronic stress, self-regulation, and coping. *Child Development Perspectives*, 7(1), 43–48. doi:10.1111/cdep.12013
- Evans, G. W. (2003). A multimethodological analysis of cumulative risk and allostatic load among rural children. *Developmental Psychology*, 39(5), 924–933.

- Fabes, R. A., Eisenberg, N. & Bernzweig, J. (1990). *The coping with children's negative emotions scales: Procedures and scoring*. Phoenix, AZ: Arizona State University.
- Fabes, R. A., Leonard, S. A., Kupanoff, K. & Martin, C. L. (2001). Parental coping with children's negative emotions: Relationships with children's emotional and social responding. *Child Development*, 72(3), 907–920. doi:10.2307/1132463
- Fabes, R. A., Poulin, R. E., Eisenberg, N. & Madden-Derdich, D. A. (2002). The coping with children's negative emotions scale (CCNES): Psychometric properties and relationships with children's emotional competence. *Marriage and Family Review*, 34, 285–310.
- Fay-Stammbach, T., Hawes, D. J. & Meredith, P. (2014). Parenting influences on executive function in early childhood: A review. *Child Development Perspectives*, 8(4), 258–264. doi:10.1111/cdep.12095
- Felitti, V., Anda, R., Williamson, D., Spitz, A., Edwards, V., Koss, M. & Marks, J. (1998). Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults. *American Journal of Preventive Medicine*, 14(4), 245–258.
- Fishbein, D., Warner, T., Krebs, C., Trevarthen, N., Flannery, B. & Hammond, J. (2009). Differential relationships between personal and community stressors and children's neurocognitive functioning. *Child Maltreatment*, 14(4), 299–315. doi:10.1177/1077559508326355
- Fox, S. E., Levitt, P. & Nelson III, C. A. (2010). How the timing and quality of early experiences influence the development of brain architecture. *Child Development*, 81(1), 28–40. doi:10.1111/j.1467–8624.2009.01380.x
- Friedman, N. P., Miyake, A., Young, S. E., DeFries, J. C., Corley, R. P. & Hewitt, J. K. (2008). Individual differences in executive functions are almost entirely genetic in origin. *Journal of Experimental Psychology: General*, 137(2), 201–225.

- Fuhs, M. W. & Day, J. D. (2011). Verbal ability and executive functioning development in preschoolers at head start. *Developmental Psychology*, 47(2), 404–416.
- Garon, N., Bryson, S. E. & Smith, S. M. (2008). Executive function in preschoolers: A review using an integrative framework. *Psychological Bulletin*, 134(1), 31–60.
- Gathercole, S. E., Pickering, S. J., Knight, C. & Stegmann, Z. (2004). Working memory skills and educational attainment: Evidence from national curriculum assessments at 7 and 14 years of age. *Applied Cognitive Psychology*, 18(1), 1–16. doi:10.1002/acp.934
- Gauvain, M. (2001). *The social context of cognitive development*. New York, NY: Guilford Press.
- Gerstadt, C. L., Hong, Y. J. & Diamond, A. (1994). The relationship between cognition and action: Performance of children 3 1/2–7 years on a Stroop-like day-night test. *Cognition*, 53, 129–153.
- Gioia, G. A., Espy, K. A. & Isquith, P. K. (2003). *The behavior rating inventory of executive function—preschool version (BRIEF-P)*. Odessa, FL: Psychological Assessment Resources.
- Gottman, J. M., Katz, L. F. & Hoover, C. (1997). *Meta-emotion: How families communicate emotionally*. Mahwah, NJ: Erlbaum.
- Graziano, P. A., Keane, S. P. & Calkins, S. D. (2010). Maternal behaviour and children's early emotion regulation skills differentially predict development of children's reactive control and later effortful control. *Infant and Child Development*, 19(4), 333–353. doi:10.1002/icd.670
- Grolnick, W. & Pomerantz, E. (2009). Issues and challenges in studying parental control: Toward a new conceptualization. *Child Development Perspectives*, 3(3), 165–170.

- Grusec, J. E. & Davidov, M. (2010). Integrating different perspectives on socialization theory and research: A domain-specific approach. *Child Development*, 81(3), 687–709. doi:10.1111/j.1467–8624.2010.01426.x
- Hackman, D. A. (2012). *Socio-economic status and the development of executive function and stress reactivity: The specific roles of parental nurturance and the home environment* (Doctoral dissertation). University of Pennsylvania, Philadelphia, PA. Available from ProQuest Dissertations & Theses Global database. (Record No. 3542813)
- Hackman, D. A., Farah, M. J. & Meaney, M. J. (2010). Socio-economic status and the brain: Mechanistic insights from human and animal research. *Nature Reviews Neuroscience*, 11(9), 651–659. doi:10.1038/nrn2897
- Hammond, S. I., Müller, U., Carpendale, J. I. M., Bibok, M. B. & Liebermann-Finestone, D. P. (2012). The effects of parental scaffolding on preschoolers' executive function. *Developmental Psychology*, 48(1), 271–281. doi:10.1037/a0025519
- Hardaway, C. R., Wilson, M. N., Shaw, D. S. & Dishion, T. J. (2012). Family functioning and externalizing behaviour among low-income children: Self-regulation as a mediator. *Infant and Child Development*, 21(1), 67–84. doi:10.1002/icd.765
- Harold, G. T., Elam, K. K., Lewis, G., Rice, F. & Thapar, A. (2012). Interparental conflict, parent psychopathology, hostile parenting, and child antisocial behavior: Examining the role of maternal versus paternal influences using a novel genetically sensitive research design. *Development and Psychopathology*, 24(Special Issue 4), 1283–1295. doi:10.1017/S0954579412000703

- Harold, G. T., Leve, L. D., Barrett, D., Elam, K., Neiderhiser, J. M., Natsuaki, M. N., .. Thapar, A. (2013). Biological and rearing mother influences on child ADHD symptoms: Revisiting the developmental interface between nature and nurture. *Journal of Child Psychology and Psychiatry*, 54(10), 1038–1046. doi:10.1111/jcpp.12100
- Hart, H. & Rubia, K. (2012). Neuroimaging of child abuse: A critical review. *Frontiers in Human Neuroscience*, 6. doi:10.3389/fnhum.2012.00052
- Haskett, M. E., Allaire, J. C., Kreig, S. & Hart, K. C. (2008). Protective and vulnerability factors for physically abused children: Effects of ethnicity and parenting context. *Child Abuse & Neglect*, 32(5), 567–576. doi:10.1016/j.chiabu.2007.06.009
- Havighurst, S. S., Wilson, K. R., Harley, A. E., Kehoe, C., Efron, D. & Prior, M. R. (2013). ‘Tuning into kids’: Reducing young children’s behavior problems using an emotion coaching parenting program. *Child Psychiatry & Human Development*, 44(2), 247–264.
- Havighurst, S., Wilson, K., Harley, A. & Prior, M. (2009). Tuning in to kids: An emotion-focused parenting program—initial findings from a community trial. *Journal of Community Psychology*, 37(8), 1008–1023.
- Healey, C. V. & Fisher, P. A. (2011). Young children in foster care and the development of favorable outcomes. *Children and Youth Services Review*, 33(10), 1822–1830. doi:10.1016/j.childyouth.2011.05.007
- Hedges, D. & Woon, F. (2011). Early-life stress and cognitive outcome. *Psychopharmacology*, 214(1), 121–130. doi:10.1007/s00213-010-2090-6
- Henry, J. D. & Crawford, J. R. (2005). The short form version of the depression anxiety stress scales (DASS-21): Construct validity and normative data in a large nonclinical sample. *British Journal of Clinical Psychology*, 44, 227–239.

- Herbers, J. E., Cutuli, J. J., Lafavor, T. L., Vrieze, D., Leibel, C., Obradovic, J. & Masten, A. S. (2011). Direct and indirect effects of parenting on the academic functioning of young homeless children. *Early Education and Development*, 22(1), 77–104. doi:10.1080/10409280903507261
- Holmbeck, G. N. (2002). Post-hoc probing of significant moderational and mediational effects in studies of pediatric populations. *Journal of Pediatric Psychology*, 27, 87–96. doi:10.1093/jpepsy/27.1.87
- Holochwost, S. J. (2013). *Cumulative risk, parenting behaviors, and the development of executive functions in early childhood: A moderating role for physiological self-regulation?* (Doctoral dissertation). The University of North Carolina at Chapel Hill, Chapel Hill, NC. Available from ProQuest Dissertations & Theses Global database. (Record No. 3593243).
- Hongwanishkul, D., Happaney, K. R., Lee, W. S. & Zelazo, P. D. (2005). Assessment of hot and cool executive function in young children: Age related changes and individual differences. *Developmental Neuropsychology*, 28(2), 617–644.
- Hopkins, J., Lavigne, J. V., Gouze, K. R., LeBailly, S. A. & Bryant, F. B. (2013). Multi-domain models of risk factors for depression and anxiety symptoms in preschoolers: Evidence for common and specific factors. *Abnormal Child Psychology*, 41(5), 705–722. doi:10.1007/s10802-013-9723-2
- Hostinar, C. E., Stellern, S. A., Schaefer, C., Carlson, S. M. & Gunnar, M. R. (2012). Associations between early life adversity and executive function in children adopted internationally from orphanages. *Proceedings of the National Academy of Sciences*, 109(Supplement 2), 17208–17212. doi:10.1073/pnas.1121246109

- Hughes, C. & Ensor, R. (2005). Executive function and theory of mind in 2 year olds: A family affair? *Developmental Neuropsychology*, 28(2), 645–668. doi:10.1207/s15326942dn2802_5
- Hughes, C. & Ensor, R. (2009). How do families help or hinder the emergence of early executive function? *New Directions for Child and Adolescent Development*, 123, 35–50. doi:10.1002/cd.234
- Hughes, C. (2011). Changes and challenges in 20 years of research into the development of executive functions. *Infant and Child Development*, 20(3), 251–271. doi:10.1002/icd.736
- Hughes, C., Ensor, R., Wilson, A. & Graham, A. (2010). Tracking executive function across the transition to school: A latent variable approach. *Developmental Neuropsychology*, 35(1), 20–36. doi:10.1080/87565640903325691
- Hughes, C., Graham, A. & Grayson, A. (2005). Executive function in childhood: Development and disorder. In J. Oates (Ed.), *Cognitive Development* (pp. 205–230). Milton Keynes, UK: Open University Press.
- Hughes, C., Roman, G., Hart, M. J. & Ensor, R. (2013). Does maternal depression predict young children’s executive function?—a 4-year longitudinal study. *Journal of Child Psychology & Psychiatry & Allied Disciplines*, 54(2), 169–177. doi:10.1111/jcpp.12014
- Isquith, P. K., Crawford, J. S., Espy, K. A. & Gioia, G. A. (2005). Assessment of executive function in preschool-aged children. *Mental Retardation and Developmental Disabilities Research Reviews*, 11(3), 209–215. doi:10.1002/mrdd.20075
- Isquith, P. K., Gioia, G. A. & Espy, K. A. (2004). Executive function in preschool children: Examination through everyday behavior. *Developmental Neuropsychology*, 26(1), 403–422. doi:10.1207/s15326942dn2601_3

- Isquith, P. K., Roth, R. & Gioia, G. (2013). Contribution of rating scales to the assessment of executive functions. *Applied Neuropsychology: Child*, 2, 125–132. doi:10.1080/21622965.2013.748389
- Jacobs, E., Miller, L. C. & Tirella, L. G. (2010). Developmental and behavioral performance of internationally adopted preschoolers: A pilot study. *Child Psychiatry and Human Development*, 41(1), 15–29.
- Jaffee, S. R. & Maikovich-Fong, A. K. (2011). Effects of chronic maltreatment and maltreatment timing on children’s behavior and cognitive abilities. *Journal of Child Psychology and Psychiatry*, 52(2), 184–194. doi:10.1111/j.1469–7610.2010.02304.x
- Jones, S., Eisenberg, N., Fabes, R. A. & MacKinnon, D. P. (2002). Parents’ reactions to elementary school children’s negative emotions: Relationships to social and emotional functioning at school. *Merrill-Palmer Quarterly*, 48(2), 133.
- Karoly, P. (1993). Mechanisms of self regulation: A systems view. *Annual Review of Psychology*, 44, 23–52.
- Karreman, A., van Tuijl, C., van Aken, M. & Dekovic, M. (2006). Parenting and self-regulation in preschoolers: A meta-analysis. *Infant and Child Development*, 15, 561–579.
- Kezelman, C., Hossack, N., Stavropoulos, P. & Burley, P. (2015). *The cost of unresolved childhood trauma and abuse in adults in Australia*. Sydney: Adults Surviving Child Abuse.
- Kim, J. & Cicchetti, D. (2010). Longitudinal pathways linking child maltreatment, emotion regulation, peer relationships, and psychopathology. *Journal of Child Psychology and Psychiatry*, 51(6), 706–716. doi:10.1111/j.1469–7610.2009.02202.x

- Kim-Spoon, J., Haskett, M. E., Longo, G. S. & Nice, R. (2012). Longitudinal study of self-regulation, positive parenting, and adjustment problems among physically abused children. *Child Abuse & Neglect*, 36(2), 95–107. doi:10.1016/j.chiabu.2011.09.016
- Kochanska, G., Murray, K. T. & Harlan, E. T. (2000). Effortful control in early childhood: Continuity and change, antecedents, and implications for social development. *Developmental Psychology*, 36, 220–232.
- Kolb, B., Mychasiuk, R., Muhammad, A., Li, Y., Frost, D. O. & Gibb, R. (2012). Experience and the developing prefrontal cortex. *Proceedings of the National Academy of Sciences*, 109(Supplement 2), 17186–17193. doi:10.1073/pnas.1121251109
- Korkman, M., Kirk, U. & Kemp, S. (2007). *NEPSY-II. Clinical and interpretive manual* (2nd ed.). San Antonio: PsychCorp.
- Kraybill, J. H. & Bell, M. A. (2013). Infancy predictors of preschool and post-kindergarten executive function. *Developmental Psychobiology*, 55(5), 530–538. doi:10.1002/dev.21057
- Lagattuta, K. H., Sayfan, L. & Monsour, M. (2011). A new measure for assessing executive function across a wide age range: Children and adults find happy-sad more difficult than day-night. *Developmental Science*, 14(3), 481–489. doi:10.1111/j.1467-7687.2010.00994.x
- Landry, S. & Smith, K. (2010). Early social and cognitive precursors and parental support for self-regulation and executive function: Relationships from early childhood into adolescence. In B. W. Sokol, U. Mueller, J. I. Carpendale, A. R. Young & G. Iarocci (Eds.), *Self-and social-regulation social interaction and the development of social understanding and executive functions* (pp. 386–417). New York, NY: Oxford University Press.

- Leve, L. D., DeGarmo, D. S., Bridgett, D. J., Neiderhiser, J. M., Shaw, D. S., Harold, G. T., .. Reiss, D. (2013). Using an adoption design to separate genetic, prenatal, and temperament influences on toddler executive function. *Developmental Psychology*, 49(6), 1045–1057. doi:10.1037/a0029390
- Lewis, C. & Carpendale, J. I. M. (2009). Introduction: Links between social interaction and executive function. *New Directions for Child and Adolescent Development*, 123, 1–15. doi:10.1002/cd.232
- Lewis, C., Koyasu, M., Oh, S., Ogawa, A., Short, B. & Huang, Z. (2009). Culture, executive function, and social understanding. *New Directions for Child and Adolescent Development*, 2009(123), 69–85. doi:10.1002/cd.236
- Lewis, E. E., Dozier, M., Ackerman, J. & Sepulveda-Kozakowski, S. (2007). The effect of placement instability on adopted children's inhibitory control abilities and oppositional behavior. *Developmental Psychology*, 43(6), 1415–1427.
- Lewis-Morrarty, E., Dozier, M., Bernard, K., Terracciano, S. M. & Moore, S. V. (2012). Cognitive flexibility and theory of mind outcomes among foster children: Preschool follow-up results of a randomized clinical trial. *Journal of Adolescent Health*, 51(2), S17–S22. doi:10.1016/j.jadohealth.2012.05.005
- Lieberman, A. F., Chu, A., Van Horn, P. & Harris, W. W. (2011). Trauma in early childhood: Empirical evidence and clinical implications. *Development and Psychopathology*, 23(02), 397–410. doi:10.1017/S0954579411000137
- Liebermann, D., Giesbrecht, G. E. & Muller, U. (2007). Cognitive and emotional aspects of self-regulation in preschoolers. *Cognitive Development*, 22(4), 511–529. doi:10.1016/j.cogdev.2007.08.005

- Liew, J. (2012). Effortful control, executive functions, and education: Bringing self-regulatory and social-emotional competencies to the table. *Child Development Perspectives*, 6(2), 105–111. doi:10.1111/j.1750–8606.2011.00196.x
- Loman, M. M., Johnson, A. E., Westerlund, A., Pollak, S. D., Nelson, C. A. & Gunnar, M. R. (2012). The effect of early deprivation on executive attention in middle childhood. *Journal of Child Psychology and Psychiatry*. doi:10.1111/j.1469–7610.2012.02602.x
- Lovejoy, M. C., Graczyk, P. A., O’Hare, E. & Neuman, G. (2000). Maternal depression and parenting behavior: A meta-analytic review. *Clinical Psychology Review*, 20(5), 561–592. doi:10.1016/S0272–7358(98)00100–7
- Lovibond, S. H. & Lovibond, P. F. (1995). *Manual for the depression anxiety stress scales* (2nd ed.). Sydney: Psychology Foundation.
- Lunkenheimer, E. S., Kemp, C. J. & Albrecht, E. C. (2013). Contingencies in mother-child teaching interactions and behavioral regulation and dysregulation in early childhood. *Social Development*, 22(2), 319–339. doi:10.1111/sode.12016
- Lunkenheimer, E. S., Shields, A. M. & Cortina, K. S. (2007). Parental emotion coaching and dismissing in family interaction. *Social Development*, 16(2), 232–248. doi:10.1111/j.1467–9507.2007.00382.x
- Luthar, S. & Cicchetti, D. (2000). The construct of resilience: Implications for interventions and social policies. *Development and Psychopathology*, 12(04), 857–885.
- Mahone, E. M. & Hoffman, J. (2007). Behavior ratings of executive function among preschoolers with ADHD. *The Clinical Neuropsychologist*, 21(4), 569–586. doi:10.1080/13854040600762724

- Mahone, E. M., Cirino, P., Cutting, L. E., Cerrone, P. M., Hagelthorn, K. M., Himenz, J.H, et al. (2002). Validity of the behavior rating inventory of executive function in children with ADHD and/or Tourette syndrome. *Archives of Clinical Neuropsychology*, 17, 635–655.
- Manly, J. T., Kim, J. E., Rogosch, F. A. & Cicchetti, D. (2001). Dimensions of child maltreatment and children's adjustment: Contributions of developmental timing and subtype. *Development and Psychopathology*, 13(04), 759–782.
- Manly, J. T., Lynch, M., Oshri, A., Herzog, M. & Wortel, S. N. (2013). The impact of neglect on initial adaptation to school. *Child Maltreatment*, 18(3), 155–170. doi:10.1177/1077559513496144
- Marshall, P. J. & Kenney, J. W. (2009). Biological perspectives on the effects of early psychosocial experience. *Developmental Review*, 29, 96–119.
- Masten, A. S. & Cicchetti, D. (2010). Developmental cascades. *Development and Psychopathology*, 22(3), 491–495. doi:10.1017/S0954579410000222
- Masten, A. S., Cutuli, J. J., Herbers, J. E., Hinz, E., Obradović, J. & Wenzel, A. J. (2014). Academic risk and resilience in the context of homelessness. *Child Development Perspectives*, 8(4), 201–206. doi:10.1111/cdep.12088
- Matte-Gagne, C. & Bernier, A. (2011). Prospective relationships between maternal autonomy support and child executive functioning: Investigating the mediating role of children's language ability. *Journal of Experimental Child Psychology*, 110(4), 611–625.
- Maughan, A. & Cicchetti, D. (2002). Impact of child maltreatment and interadult violence on child emotion regulation abilities and socio-motional adjustment. *Child Development*, 73(5), 1525–1542. doi:10.1111/1467–8624.00488

- McAlister, A. R., & Peterson, C. C. (2013). Siblings, Theory of Mind, and Executive Functioning in Children Aged 3–6 Years: New Longitudinal Evidence. *Child Development*, 84(4), 1442–1458. doi: 10.1111/cdev.12043
- McAuley, T., Chen, S., Goos, L., Schachar, R. & Crosbie, J. (2010). Is the behavior rating inventory of executive function more strongly associated with measures of impairment or executive function? *Journal of the International Neuropsychological Society*, 16(03), 495–505. doi:10.1017/S1355617710000093
- McCandless, S. & O’Laughlin, L. (2007). The clinical utility of the behavior rating inventory of executive function (BRIEF) in the diagnosis of ADHD. *Journal of Attention Disorders*, 10(4), 381–389. doi:10.1177/1087054706292115
- McClelland, M. M. & Cameron, C. E. (2012). Self-regulation in early childhood: Improving conceptual clarity and developing ecologically valid measures. *Child Development Perspectives*, 6(2), 136–142. doi:10.1111/j.1750–8606.2011.00191.x
- McCrory, E., De Brito, S. A. & Viding, E. (2010). Research review: The neurobiology and genetics of maltreatment and adversity. *Journal of Child Psychology and Psychiatry*, 51(10), 1079–1095. doi:10.1111/j.1469–7610.2010.02271.x
- McDermott, J. M., Westerlund, A., Zeanah, C. H., Nelson, C. A. & Fox, N. A. (2012). Early adversity and neural correlates of executive function: Implications for academic adjustment. *Developmental Cognitive Neuroscience*, 2(Supplement 1), S59–S66. doi: 10.1016/j.dcn.2011.09.008
- McEwen, B. S. (2012). Brain on stress: How the social environment gets under the skin. *Proceedings of the National Academy of Sciences*, 109(Supplement 2), 17180–17185. doi:10.1073/pnas.1121254109

- Mence, M., Hawes, D. J., Wedgwood, L., Morgan, S., Barnett, B., Kohlhoff, J. & Hunt, C. (2014). Emotional flooding and hostile discipline in the families of toddlers with disruptive behavior problems. *Journal of Family Psychology*, 28(1), 12–21.
- Merz, E. C. & McCall, R. B. (2011). Parent ratings of executive functioning in children adopted from psychosocially depriving institutions. *Journal of Child Psychology and Psychiatry*, 52, 537–546. doi:10.1111/j.1469–7610.2010.02335.x
- Merz, E. C., McCall, R. B. & Groza, V. (2013). Parent-reported executive functioning in postinstitutionalized children: A follow-up study. *Journal of clinical child and adolescent psychology*, 42(5), 726–733.
- Mezzacappa, E., Buckner, J. C. & Earls, F. (2011). Prenatal cigarette exposure and infant learning stimulation as predictors of cognitive control in childhood. *Developmental Science*, 14(4), 881–891.
- Mezzacappa, E., Kindlon, D. & Earls, F. (2001). Child abuse and performance task assessments of executive functions in boys. *Journal of Child Psychology and Psychiatry*, 42(8), 1041–1048. doi:10.1111/1469–7610.00803
- Micco, J. A., Henin, A., Biederman, J., Rosenbaum, J. F., Petty, C., Rindlaub, L. A., .. Hirshfeld-Becker, D. R. (2009). Executive functioning in offspring at risk for depression and anxiety. *Depression and Anxiety*, 26(9), 780–790. doi:10.1002/da.20573
- Miller, E. & Cohen, J. (2001). An integrative theory of prefrontal cortex function. *Annual Reviews of Neuroscience*, 24, 167–202.
- Miller, M. R., Giesbrecht, G. F., Müller, U., McInerney, R. J. & Kerns, K. A. (2012). A latent variable approach to determining the structure of executive function in preschool children. *Journal of Cognition and Development*, 13(3), 395–423. doi:10.1080/15248372.2011.585478

- Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A. & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex ‘frontal lobe’ tasks: A latent variable analysis. *Cognitive Psychology*, 41(1), 49–100.
- Moffitt, T. E., Arseneault, L., Belsky, D., Dickson, N., Hancox, R. J., Harrington, H., ... Caspi, A. (2011). A gradient of childhood self-control predicts health, wealth, and public safety. *Proceedings of the National Academy of Science USA*, 108(7), 2693–2698.
- Moradi, A. R., Doost, H. T., Taghavi, M. R., Yule, W. & Dalgleish, T. (1999). Everyday memory deficits in children and adolescents with PTSD: Performance of the Rivermead behavioural memory test. *Journal of Child Psychology and Psychiatry*, 40, 357–361.
- Morris, A. S., Silk, J. S., Morris, M. D., Steinberg, L., Aucoin, K. J. & Keyes, A. W. (2011). The influence of mother-child emotion regulation strategies on children’s expression of anger and sadness. *Developmental Psychology*, 47(1), 213–225.
- Morris, A. S., Silk, J. S., Steinberg, L., Myers, S. S. & Robinson, L. R. (2007). The role of the family context in the development of emotion regulation. *Social Development*, 16(2), 361–388. doi:10.1111/j.1467-9507.2007.00389.x
- Müller, U., Liebermann-Finestone, D. P., Carpendale, J. I. M., Hammond, S. I. & Bibok, M. B. (2012). Knowing minds, controlling actions: The developmental relationships between theory of mind and executive function from 2 to 4 years of age. *Journal of Experimental Child Psychology*, 111(2), 331–348. doi:10.1016/j.jecp.2011.08.014
- NICHD Early Child Care Research Network. (2005). Predicting individual differences in attention, memory, and planning in first graders from experiences at home, child care, and school. *Developmental Psychology*, 41(1), 99–114.

- Nigg, J. (2000). On inhibition /disinhibition in developmental psychopathology: Views from cognitive and personality psychology and a working inhibition taxonomy. *Psychological Bulletin*, 126(2), 220–246.
- Noble, K. G., Houston, S. M., Kan, E. & Sowell, E. R. (2012). Neural correlates of socio-economic status in the developing human brain. *Developmental Science*, 15(4), 516–527. doi:10.1111/j.1467–7687.2012.01147.x
- Noble, K., McCandliss, B. & Farah, M. (2007). Socio-economic gradients predict individual differences in neurocognitive abilities. *Developmental Science*, 10(4), 464–480.
- O'Connor, T. G. (2002). Annotation: The 'effects' of parenting reconsidered: Findings, challenges, and applications. *Journal of Child Psychology and Psychiatry*, 43(5), 555–572. doi:10.1111/1469–7610.00046
- Obradovic, J. (2010). Effortful control and adaptive functioning of homeless children: Variable-focused and person-focused analyses. *Journal of Applied Developmental Psychology*, 31(2), 109–117. doi:10.1016/j.appdev.2009.09.004
- Oh, S. & Lewis, C. (2008). Korean preschoolers' advanced inhibitory control and its relationship to other executive skills and mental state understanding. *Child Development*, 79(1), 80–99. doi:10.1111/j.1467–8624.2007.01112.x
- Olson, S. L., Tardif, T. Z., Miller, A., Felt, B., Grabell, A. S., Kessler, D., .. Hirabayashi, H. (2011). Inhibitory control and harsh discipline as predictors of externalizing problems in young children: A comparative study of U.S., Chinese, and Japanese preschoolers. *Journal of Abnormal Child Psychology*, 39(8), 1163–1175. doi:10.1007/s10802–011–9531–5
- Parenting Research Centre. (2013). *Evidence review: Analysis of evidence for parenting interventions for parents of vulnerable children*. Melbourne, Victoria: Parenting Research Centre.

- Pasalich, D. S., Dadds, M. R., Vincent, L. C., Cooper, F. A., Hawes, D. J. & Brennan, J. (2012). Emotional communication in families of conduct problem children with high versus low callous-unemotional traits. *Journal of Clinical Child & Adolescent Psychology*, 41(3), 302–313. doi:10.1080/15374416.2012.668844
- Pauli-Pott, U. & Becker, K. (2011). Neuropsychological basic deficits in preschoolers at risk for ADHD: A meta-analysis. *Clinical Psychology Review*, 31(4), 626–637. doi: 10.1016/j.cpr.2011.02.005
- Pears, K. C. & Fisher, P. A. (2005). Developmental, cognitive, and neuropsychological functioning in preschool-aged foster children: Associations with prior maltreatment and placement history. *Journal of Developmental and Behavioral Pediatrics*, 26(2), 112–122. doi:10.1097/00004703-200504000-00006
- Pears, K. C., Fisher, P. A., Bruce, J., Kim, H. K. & Yoerger, K. (2010). Early elementary school adjustment of maltreated children in foster care: The roles of inhibitory control and caregiver involvement. *Child Development*, 81(5), 1550–1564.
- Pechtel, P. & Pizzagalli, D. (2011). Effects of early life stress on cognitive and affective function: An integrated review of human literature. *Psychopharmacology*, 214(1), 55–70. doi:10.1007/s00213-010-2009-2
- Pennington, B. G. & Ozonoff, S. (1996). Executive function and developmental psychopathology. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, 37(51–87).
- Pollak, S. D., Nelson, C. A., Schlaak, M. F., Roeber, B. J. & Wewerka, S. (2010). Neurodevelopmental effects of early deprivation in post-institutionalized children. *Child Development*, 81, 224–236.

- Posner, M. I., Rothbart, M. K., Sheese, B. E. & Tang, Y. (2007). The anterior cingulate gyrus and the mechanism of self-regulation. *Cognitive Affective & Behavioral Neuroscience*, 7(4), 391–395.
- Poulin-Dubois, D., Blaye, A., Coutya, J. & Bialystok, E. (2011). The effects of bilingualism on toddlers' executive functioning. *Journal of Experimental Child Psychology*, 108(3), 567–579. doi:10.1016/j.jecp.2010.10.009
- Raver, C. C., Jones, S. M., Li-Grining, C., Zhai, F., Bub, K. & Pressler, E. (2011). CSRP's impact on low-income preschoolers' preacademic skills: Self-regulation as a mediating mechanism. *Child Development*, 82(1), 362–378. doi:10.1111/j.1467–8624.2010.01561.x
- Raver, C. C., McCoy, D., Lowenstein, A. & Pess, R. (2013). Predicting individual differences in low-income children's executive control from early to middle childhood. *Developmental Science*, 16(3), 394–408. doi:10.1111/desc.12027
- Reynolds, R.W. & Kamphaus, C.R. (2006). *PRQ: Parent relationship questionnaire manual*. Minneapolis, MN: NCS Pearson.
- Rhoades, B. L., Greenberg, M. T. & Domitrovich, C. E. (2009). The contribution of inhibitory control to preschoolers' social-emotional competence. *Journal of Applied Developmental Psychology*, 30(3), 310–320. doi:10.1016/j.appdev.2008.12.012
- Rhoades, B. L., Greenberg, M. T., Lanza, S. T. & Blair, C. (2011). Demographic and familial predictors of early executive function development: Contribution of a person-centered perspective. *Journal of Experimental Child Psychology*, 108(3), 638–662. doi:10.1016/j.jecp.2010.08.004
- Robinson, L. A., Morris, A. S., Heller, S. S., M.S, S., Boris, N. W. & Smyke, A. T. (2009). Relationships between emotion regulation, parenting and psychopathology in young maltreated children in out of home care. *Journal of Family Studies*, 18, 421–434.

- Roskam, I., Meunier, J. C., Stievenart, M. & Noel, M. P. (2013). When there seem to be no predetermining factors: Early child and proximal family risk predicting externalizing behavior in young children incurring no distal family risk. *Research in Developmental Disabilities*, 34(1), 627–639. doi:10.1016/j.ridd.2012.10.002
- Rothbart, M. K. & Bates, J. E. (2006). Temperament. In N. Eisenberg & W. Damon (Eds.), *Handbook of child psychology. Social, emotional, and personality development* (6th ed., Vol. 3, pp. 99–166). New York, NY: Wiley.
- Rutter, M. (2012). Annual research review: Resilience: Clinical implications. *Journal of Child Psychology and Psychiatry*, 1–14. doi:10.1111/j.1469-7610.2012.02615.x
- Sameroff, A. J. (2010). A unified theory of development: A dialectic integration of nature and nurture. *Child Development*, 81(1), 6–22. doi:10.1111/j.1467-8624.2009.01378.x
- Sanchez, M., Ladd, C. & Plotsky, P. (2001). Early adverse experience as a developmental risk factor for later psychopathology. Evidence from rodent and primate models. *Development and Psychopathology*, 13, 419–449.
- Sanders, M. R. & Mazzucchelli, T. G. (2013). The promotion of self-regulation through parenting interventions. *Clinical Child and Family Psychology Review*, 16(1), 1–17. doi:10.1007/s10567-013-0129-z
- Sarsour, K., Sheridan, M., Jutte, D., Nuru-Jeter, A., Hinshaw, S. & Boyce, W. T. (2011). Family socio-economic status and child executive functions: The roles of language, home environment, and single parenthood. *Journal of the International Neuropsychological Society*, 17(1), 120–132. doi:10.1017/s1355617710001335
- Schoemaker, K., Bunte, T., Wiebe, S. A., Espy, K. A., Deković, M. & Matthys, W. (2012). Executive function deficits in preschool children with ADHD and DBD. *Journal of Child Psychology and Psychiatry*, 53(2), 111–119. doi:10.1111/j.1469-7610.2011.02468.x

- Schoemaker, K., Mulder, H., Deković, M. & Matthys, W. (2013). Executive functions in preschool children with externalizing behavior problems: A meta-analysis. *Journal of abnormal child psychology*, 41(3), 457–471. doi:10.1007/s10802-012-9684-x
- Shallice, T., Marzocchi, G. M., Coser, S., Savio, M. D., Meuter, R. F. & Rumiati, R. I. (2002). Executive function profile of children with attention deficit hyperactivity disorder. *Developmental Neuropsychology*, 21(1), 43–71.
- Sherman, E. M. S. & Brooks, B. L. (2010). Behavior rating inventory of executive function-preschool version (BRIEF-P): Test review and clinical guidelines for use. *Child Neuropsychology*, 16, 503–519. doi:10.1080/09297041003679344
- Shields, A. & Cicchetti, D. (1998). Reactive aggression among maltreated children: The contributions of attention and emotion dysregulation. *Journal of Clinical Child Psychology*, 27(4), 381–395. doi:10.1207/s15374424jccp2704_2
- Shing, Y. L., Lindenberger, U., Diamond, A., Li, S. & Davidson, M. (2010). Memory maintenance and inhibitory control differentiate from early childhood to adolescence. *Developmental Neuropsychology*, 35(6), 679–697. doi:10.1080/87565641.2010.508546
- Shipman, K. L. & Zeman, J. (2001). Socialization of child emotion regulation in mother-child dyads: A developmental psychopathology perspective. *Development and Psychopathology*, 13(2), 317–336.
- Shipman, K. L., Schneider, R., Fitzgerald, M. M., Sims, C., Swisher, L. & Edwards, A. (2007). Maternal emotion socialization in maltreating and non-maltreating families: Implications for child emotion regulation. *Social Development*, 16(2), 268–285. doi:10.1111/j.1467-9507.2007.00384.x

- Shonkoff, J. P. (2010). Building a new biodevelopmental framework to guide the future of early childhood policy. *Child Development*, 81(1), 357–367. doi:10.1111/j.1467–8624.2009.01399.x
- Shonkoff, J. P. (2011). Protecting brains, not simply stimulating minds. *Science*, 333(6045), 982–983. doi:10.1126/science.1206014
- Silver, C. H. P. (2000). Ecological validity of neuropsychological assessment in childhood traumatic brain injury. *Journal of Head Trauma Rehabilitation*, 15(4), 973–988.
- Spinrad, T. L., Eisenberg, N., Gaertner, B., Popp, T., Smith, C. L., Kupfer, A., Hofer, C. (2007). Relationships of maternal socialization and toddlers’ effortful control to children’s adjustment and social competence. *Developmental Psychology*, 43(5), 1170–1186. doi:10.1037/0012–1649.43.5.1170
- Spinrad, T. L., Stifter, C. A., Donelan McCall, N. & Turner, L. (2004). Mothers’ regulation strategies in response to toddlers’ affect: Links to later emotion self-regulation. *Social Development*, 13, 40–55.
- Snyder, J., Stoolmiller, M., Wilson, M. & Yamamoto, M. (2003). Child anger regulation, parental responses to children’s anger displays, and early child antisocial behavior. *Social Development*, 12(3), 335–360.
- Tabachnick, B.G & Fidell, L.S. (2007) *Using multivariate statistics* (5th ed.). Boston, MA: Pearson/Allyn & Bacon.
- Tang, Y.-Y., Yang, L., Leve, L. D. & Harold, G. T. (2012). Improving executive function and its neurobiological mechanisms through a mindfulness-based intervention: advances within the field of developmental neuroscience. *Child Development Perspectives*, 6(4), 361–366. doi:10.1111/j.1750–8606.2012.00250.x

- Tarabulsky, G. M. P., Pascuzzo, K. B., Moss, E. P., St-Laurent, D. P., Bernier, A. P., Cyr, C. P. & Dubois-Comtois, K. P. (2008). Attachment-based intervention for maltreating families. *American Journal of Orthopsychiatry*, 78(3), 322–332.
- Taylor, S. E., Repetti, R. L. & Seeman, T. (1997). Health psychology: What is an unhealthy environment and how does it get under the skin? *Annual Review of Psychology*, 48(1), 411–447. doi:10.1146/annurev.psych.48.1.411
- Teicher, M. H., Anderson, S. L., Polcari, A., Anderson, C., Navalta, C. & Kim, D. (2003). The neurobiological consequences of early stress and childhood maltreatment. *Neuroscience and Biobehavioral Reviews*, 27, 33–44.
- Thompson, R. A. (1994). Emotion regulation: A theme in search of definition. *Monographs of the Society for Research in Child Development*, 59(2–3, 290), 25–52. doi:10.1111/j.1540-5834.1994.tb01276.x
- Thorell, L. B. & Nyberg, L. (2008). The childhood executive functioning inventory (CHEXI): A new rating instrument for parents and teachers. *Developmental Neuropsychology*, 33(4), 536–552. doi:10.1080/87565640802101516
- Toplak, M. E., West, R. F. & Stanovich, K. E. (2013). Do performance-based measures and ratings of executive function assess the same construct? *Journal of Child Psychology and Psychiatry*, 52(2), 131–143. doi:10.1111/jcpp.12001
- Trickett, P. K. & McBride-Chang, C. (1995). The developmental impact of different types of child abuse and neglect. *Developmental Review*, 15, 311–337.
- Ursache, A., Blair, C. & Raver, C. C. (2012). The promotion of self-regulation as a means of enhancing school readiness and early achievement in children at risk for school failure. *Child Development Perspectives*, 6(2), 122–128. doi:10.1111/j.1750-8606.2011.00209.x

- Valiente, C., Lemery-Chalfant, K. & Reiser, M. (2007). Pathways to problem behaviors: Chaotic homes, parent and effortful control, and parenting. *Social Development*, 16(2), 249–267.
- Velleman, P. F. (1981). Efficient computing of regression diagnostics. *American Statistician*, 35, 234–242. doi:10.2307/2683296
- Weber, R. C. (2011). *How hot or cool is it to speak two languages: Executive function advantages in bilingual children* (Doctoral dissertation). Texas A&M University, College Station, TX. Available from ProQuest Dissertations & Theses Global database. (Record No. 3486149).
- Weintraub, S., Bauer, P. J., Zelazo, P. D., Wallner-Allen, K., Dikmen, S. S., Heaton, R. K., .. Gershon, R. C. (2013). National institutes of health toolbox cognition battery (NIH Toolbox CB): Validation for children between 3 and 15 years: I. NIH Toolbox cognition battery (CB): Introduction and pediatric data. *Monographs of the Society for Research in Child Development*, 78(4), 1–15. doi:10.1111/mono.12031
- White, O. G., Hindley, N. & Jones, D. P. (2014). Risk factors for child maltreatment recurrence: An updated systematic review. *Medicine, Science and the Law*. doi:10.1177/0025802414543855
- Wiebe, S. A., Espy, K. A. & Charak, D. (2008). Using confirmatory factor analysis to understand executive control in preschool children: I. Latent structure. *Developmental Psychology*, 44(2), 575–587.
- Wiebe, S. A., Sheffield, T., Nelson, J. M., Clark, C. A. C., Chevalier, N. & Espy, K. A. (2011). The structure of executive function in 3-year-olds. *Journal of Experimental Child Psychology*, 108(3), 436–452. doi:10.1016/j.jecp.2010.08.008

- Wilbarger, J., Gunnar, M., Schneider, M. & Pollak, S. D. (2010). Sensory processing in internationally adopted, post-institutionalized children. *Journal of Child Psychology and Psychiatry*, 51(10), 1105–1114. doi:10.1111/j.1469-7610.2010.02255.x
- Willoughby, M. (2013). Measurement of executive function in early childhood. In *Measures of social-emotional development* (pp. 43–48). Washington, DC: Federal Interagency Forum on Child and Family Statistics.
- Willoughby, M., Pek, J., Blair, C. B. & Family Life Project, I. (2013). Measuring executive function in early childhood: A focus on maximal reliability and the derivation of short forms. *Psychological Assessment*, 25(2), 664–670.
- Wittke, K., Spaulding, T. J. & Schechtman, C. J. (2013). Specific language impairment and executive functioning: Parent and teacher ratings of behavior. *American Journal of Speech-Language Pathology*, 22(2), 161–172. doi:10.1044/1058-0360(2012/11-0052)
- Yates, T. M., Obradovic, J. & Egeland, B. (2010). Transactional relationships across contextual strain, parenting quality, and early childhood regulation and adaptation in a high-risk sample. *Development and Psychopathology*, 22(3), 539–555. doi:10.1017/S095457941000026X
- Zelazo, P. D. & Carlson, S. M. (2012). Hot and cool executive function in childhood and adolescence: Development and plasticity. *Child Development Perspectives*, 6(4), 354–360. doi:10.1111/j.1750-8606.2012.00246.x
- Zelazo, P. D. & Lyons, K. E. (2012). The potential benefits of mindfulness training in early childhood: A developmental social-cognitive neuroscience perspective. *Child Development Perspectives*, 6(2), 154–160. doi:10.1111/j.1750-8606.2012.00241.x
- Zelazo, P. D. (2006). The dimensional change card sort (DCCS): A method of assessing executive function in children. *Nature Protocols*, 1(1), 297–301.

- Zelazo, P. D. (2013). Developmental psychology: A new synthesis. In P. D. Zelazo (Ed.), *The Oxford handbook of developmental psychology* (Vol. 1, pp. 3–12). New York, NY: Oxford University Press.
- Zelazo, P. D., Carter, A., Reznick, J. S. & Frye, D. (1997). Early development of executive function: A problem-solving framework. *Review of General Psychology*, 1, 198–226.
- Zelazo, P. D., Frye, D. & Rapus, T. (1996). An age-related dissociation between knowing rules and using them. *Cognitive Development*, 11, 37–63.
- Zhou, Q., Chen, S. H. & Main, A. (2012). Commonalities and differences in the research on child effortful control and executive function: A call for an integrated model of self-regulation. *Child Development Perspectives*, 6(2), 112–121. doi:10.1111/j.1750–8606.2011.00176.x

Appendix

Test Protocols for Executive Function Measures and Demographic Questionnaire

Individual child assessments were conducted in a quiet, corner or private room free from distractions, within the child care center or home. Two chairs (one for the examiner and child) and a table of appropriate child height were used. The parent was invited to sit next to the child and complete their questionnaire package while the child was administered the child measures of executive function and receptive language by the examiner. The child measures were administered in the following order: Happy-Sad Stroop, Tapping Test, Dimensional Change Card Test, Peabody Picture Vocabulary Test.

Happy-Sad Stroop

This recently developed Happy-Sad Stroop task (Lagattuta, Sayfan, Monsour, 2011) measures executive function and requires participants to hold two rules in mind and to inhibit saying what the stimulus really represents (a prepotent response). For this task, participants were instructed to say ‘happy’ in response to a picture of a sad face and ‘sad’ when they viewed a happy face. This EF measure is advantageous over the traditional ‘day-night’ stroop test because of its suitability for a wider age range (from 4 to adulthood) without susceptibility to floor or ceiling effects. Given that categorization of happy versus sad emerges as early as infancy, the authors of this task proposed that children and adults would find it challenging to say the opposite emotion for each face. The happy–sad task consisted of eight 3 x 3 inch black/white scale pictures of happy faces and eight identically sized black/white scale pictures of sad faces. The examiner presented each of the 16 cards to the child in a fixed random order, and then placed the card face down on the table after the participant’s response.

Training and instructions

The participant was first trained and given two practice trials (1 happy card and 1 sad card).

Here is a picture of a face. Is it happy or sad? (wait for participant's response) Right, happy!

Here is another picture of a face. Is it happy or sad? (wait for participant's response) Right, sad!

Once the child was able to recognize the symbol, instructions for the game were then verbally given. Participants were instructed to say the opposite label for each picture ("happy" for a sad face, "sad" for a happy face) as follows: *OK, we are going to play a Silly Game. When you see this card (happy face), I want you to say the opposite – which is sad. That's why it's a silly game.* Examiner turns over a card with a sad face, *When you see this card, I want you to say, happy.* Each child is then given 2 practice trials (1 happy card and 1 sad card) and then asked, *What do you say when I show you this card?*

Each child is given 2 trials. If child is wrong on the first card, tell him the correct answer and then go on to the next card. If the child is wrong on the next card, tell him the correct answer. If the subject is wrong on either card, repeat the practice again after reminding the child of the rules. Correct for any errors. If the child is still wrong, stop practice and begin testing anyway, but give a final explanation of the rules. If the child self-corrects during practice and shows understanding of the rules, then another practice is not needed. There are 16 trials, in which 8 "happy" cards and 8 "sad" cards are presented according to a pseudo-random schedule. The cards are presented in the order: happy(h), sad(s), h, s, h, s, h, s, h, s, h, s, h, s, h, s. During the 16 test trials, no feedback is given to the subjects on their responses. Emphasize smooth presentation, while presenting and flipping the cards in a rhythmic manner.

Scoring

The first response is always counted, whether it is right or wrong, although it is noted when the child self-corrected (write SC). The test is scored by counting the number of correct responses out of 16.

The Tapping Test

The Tapping Test (Diamond & Taylor, 1996) is a measure of inhibitory control and working memory. Materials include one 16 cm thin wooden dowel rod (1 cm diameter). This measure is used to assess children's ability to inhibit a natural tendency to mimic the examiner's action, while remembering the rule for the correct action.

Training and instructions

The participant is trained initially on the first rule and given two practice trials (each consisting of tap once, tap twice) before proceeding to testing. The second rule is then presented, with two practice trials prior to testing.

We are going to play a game with this stick. I'm going to tap this stick and then I'm going to give it to you so that you can tap. When you are finished, you give it back to me so that I can tap some more. OK, this is what I want you to do. The first rule in this tapping game is to copy what I do. Demonstrate with "If I tap one time, you tap one time. If I tap two times, you tap 2 times. Let's practice together. If I tap one time, you tap 1 one time (student taps). If I tap two times, then you also tap two times (demonstrate). Okay are you ready to practice (no verbal cues, hand the dowel to child each time).

Examiner taps one time and hands dowel to child to tap, then the examiner taps two times and waits for the child to tap two times. If the child was correct again, the child was praised. If the child responded incorrectly on either of these trials, after the two trials were over, the experimenter reminded the child of both rules again, explaining first the rule the child had executed incorrectly. Then testing began.

Each session consisted of a pseudorandom series of 16 trials; each trial was composed of the examiner's tap(s) followed by the subject's response tap. The series of taps was as follows: 1,2,2,1,2,2,1,1,1,2,1,2,2,1,1,2. Only one dowel for both the examiner and child was used so neither would begin tapping before the other had finished. Experimenters were carefully trained to avoid influencing the child's response by reaching for the dowel too early or by leaving it with the child too long. No feedback was given during testing.

Good, now we are going to play the tapping game with a new rule. Instead of copying what I do, you tap the opposite to me. Demonstrate with, If I tap one time, you tap two times. But if I tap two times, then you tap one time. Remember, do the opposite to me. Let's practice together. If I tap one time, you tap two times (student taps). If I tap two times, then you tap one time (student taps). OK are you ready to practice? No verbal cues are provided to help the child. Examiner taps one time and hands dowel to child to tap who responds with two taps, then the examiner taps two times and waits for the child to tap one time. If the child was correct again, the child was praised, and these two trials counted as the first two trials of testing. If the child responded incorrectly on either of these trials, after the two trials were over, the experimenter reminded the child of both rules again, explaining first the rule the child had executed incorrectly. Then testing began. This session consisted of a pseudorandom series of 16 trials; each trial was composed of the experimenter's tap(s) followed by the subject's response tap. The series of taps was as follows: 1,2,2,1,2,2,1,1,1,2,1,2,2,1,1,2.

Scoring

For this study the score for Rule 2 or the post-switch tapping (opposite not the same sequence) was used, calculated by counting the numbers of correct items out of 16 e.g., 12/16 or 0.75.

Dimensional Card Sort Test

The DCCS is a widely used and easy to administer measure of executive function suitable for young children (Zelazo, 2006). This test measures children's attentional/flexibility, rule

use, inhibitory control and working memory (Diamond et al., 2005; Zelazo, Frye & Rapus, 1996). In the standard version for children 3-5 years, children are asked to sort cards according to one dimension (e.g. colour). During a post-switch phase, they are told to sort the same types of test cards according to the other dimension (e.g. shape). This test uses 12 laminated white cards, six cards depict a picture of a blue boat and the six other cards depict a red star. Two sorting trays made out of a plastic DVD cover are placed on the table in front of the child, with a target card (blue truck and red star) displayed on each of the trays.

Training and instructions

We're going to play card game now. In this game we can play the colour (shape) game. In the colour (shape) game all the blue ones (all the trucks) go here, and all the red ones (all the stars) go here. Okay? Practice with the bird and boat colours. Can you show me where the blue ones (trucks) go? (Praise or correct). And where do the red ones (stars) go? (Praise or correct). Practice trials: Here's a blue one, where does it go? (praise or correct). Here's a red one (star). Where does it go? (Praise or correct). The examiner takes one card at a time and places it face-down in the tray where the child indicates. Give maximum of two practices on each colour.

Great job! Let's keep playing the colour (shape) game. Remember (child's name) in the colour (shape) game, all the blues ones (trucks) go here and all the red ones go here. After six cards for this (colour) sort, the dimension is changed.

We're not going to play the colour game anymore. We're going to play a new game – we're going to play the shape game now. Remember, in the shape game, all the trucks go here, and all the stars go here. So, stars go there, and trucks go here. Take a card, can you show me where the truck goes in the shape game? (child points and given feedback). Now, can you show me where the goes? (child points and given feedback). Here's a truck, where does it go? Here's a star Where does it go?

After maximum of two practice trials, the second rule is repeated again prior to the child being presented with six cards individually. Each time the child is asked where does the truck or star go, and the examiner places each card face down in the tray chosen by the child.

Scoring

For this study the DCCS was scored based on the post-switch or Rule 2 (shape categorization) calculated by counting the number of correct trials out of six. Many other studies have used a binary pass fail for the post-switch dimension with 5 out of six regarded as a pass.

PPVT-III.

The PPVT-III is an individually, norm-referenced test for receptive vocabulary designed for use with persons aged 2.5 to 90 years. Form III-A was administered to all child participants. To begin the test, the child was introduced to the test with some training items. The child is required to select one of four black/white pictures per page that best represents the word spoken by the examiner. The examiner says aloud the stimulus word that the respondent identifies by pointing or saying. Test responses are recorded on the test form. Start points and basal and ceiling levels are specified.

I have some pictures to show you. See all the pictures on this page. I will say something; then I want you to put your finger on the picture of what I have said. Let's try one. Put your finger on ball. Good! Let's try another one. Put your finger on dog. If the child responds incorrectly, demonstrate the correct response by pointing to the ball and saying: *You tried, but this is the ball. Now try again. Put your finger on ball.* Before commencing with the test, the child must respond correctly and without help to at least two consecutive training words on Training Items A and B.

The examiner teaches the participant to respond in a manner that is suitable. For example, allowable verbal instructions include, Put your finger on...., Show me...., and Find

Scoring

A raw score is converted to standardized scores. Age equivalent and percentile scores are also obtained. For this study the standardized scores were used.

Child Coding Sheet for scoring the executive function measures
Happy-Sad Stroop

<i>Practices Required: 1, 2, 3</i>			
Trial	Code (✓ or ✗) SC (self correct)	Trial	Code (✓ or ✗) SC (self correct)
1. H		9. S	
2. S		10. H	
3. S		11. S	
4. H		12. H	
5. S		13. H	
6. H		14. S	
7. H		15. H	
8. S		16. S	

Percent correct (range 0-1) =

Peg tapping Test (congruent)

<i>Rule 1, Rule 2 demonstrations Required: 1, 2, 3</i>			
Trial (congruent)	Code (✓ or ✗),	Trial (congruent)	Code (✓ or ✗),
1) 1		9) 1	
2) 2		10) 2	
3) 2		11) 1	
4) 1		12) 2	
5) 2		13) 2	
6) 2		14) 1	
7) 1		15) 1	
8) 1		16) 2	

Percent correct (range 0-1) =

Peg tapping Test (incongruent)

<i>Rule 1, Rule 2 demonstrations Required: 1, 2, 3</i>			
Trial (incongruent)	Code (✓ or ✗),	Trial (incongruent)	Code (✓ or ✗),
1) 1		9) 1	
2) 2		10) 2	
3) 2		11) 1	
4) 1		12) 2	
5) 2		13) 2	
6) 2		14) 1	
7) 1		15) 1	
8) 1		16) 2	

Percent correct (range 0-1) =

Card Sort Test

Pre-switch Practices required: 1, 2		Post-switch Practices required: 1, 2	
1.		1.	
2.		2.	
3.		3.	
4.		4.	
5.		5.	
6.		6.	
Total correct (out of 6) =		Total correct (out of 6) =	

Study of Self Regulation in Preschoolers	Date / / 2010	FW Initials	FAMID
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Child's Family Background Questionnaire

This questionnaire which asks questions about your child's family background is to be completed by either parent. Please place a clear "X" in the appropriate boxes.

- What is the gender of the preschool aged child in this study? Female ☐ Male ☐
- What is the birth date of the child in this study? ____/____/____
- Which of the following best describes your relationship to the child in this study?
 - Natural (birth or adopted) mother ☐
 - Natural (birth or adopted) father ☐
 - Stepmother ☐
 - Stepfather ☐
 - Other (pls describe)_____ ☐
- What age were the child's parents when this child was born?
 - Father _____ years
 - Mother _____ years
- Is this child of Aboriginal or Torres Strait Islander origin?
 - No ☐
 - Yes, Aboriginal ☐
 - Yes, Torres Strait Islander ☐
- Do the child's parents originate from another country?

	Mother	Father
No, born in Australia	☐	☐
Yes, which country/s? _____	☐	☐
- Does the child speak a language other than English at home?
 - No, only English ☐
 - Yes, which language? ☐ _____
- Which of the following best describes the parents (or parental figures) *currently* living in the child's household?
 - Two natural parents ☐
 - Mother and stepfather/defacto ☐
 - Father and stepmother/defacto ☐
 - Mother alone ☐

	Father alone	☐
	Other (pls specify)	☐ _____

9. Has the child always lived with these parents/ carers?

Yes, child has *a/ways* lived with these parents/carers? ☐

No, child has had changes in these parents/carers? ☐

10. How many dependent children (18 year or younger) live with you in the home? ☐

What are the ages (in years) of these children?

☐ years ☐ years ☐ years ☐ years ☐ years ☐ years

11. What is the highest level of completed education of each parent?

	Mother	Father
Primary school	☐	☐
Year 10 high school	☐	☐
Year 12, HSC or equivalent	☐	☐
Technical, trade or TAFE certificate	☐	☐
Completed university qualifications	☐	☐
Other (pls specify) _____	☐	☐

12. What is the main source of current income for each parent?

	Mother	Father
Full time paid employment	☐	☐
Part time paid employment	☐	☐
Centrelink pension/benefit	☐	☐
Other (please describe) _____	☐	☐

13. Does the child attend regular child care outside of the home?

No ☐

Yes ☐ (days/week)

If yes, specify the type of child-care?

Family day care	☐
Centre based child care	☐
Other (please describe)	☐ _____