CHILD ADVERSITY, EXECUTIVE FUNCTION, AND PARENTING

ASSOCIATIONS BETWEEN MATERNAL ADVERSE CHILDHOOD EXPERIENCES, EXECUTIVE FUNCTION, AND EMOTIONAL AVAILABILITY IN MOTHER-CHILD DYADS

By MADELEINE HARRIS, B.H.Sc.

A Thesis Submitted to the School of Graduate Studies

in Partial Fulfilment of the Requirements

for the Degree Master of Science

McMaster University

MASTER OF SCIENCE (2020)
(Neuroscience)

McMaster University
Hamilton, Ontario

TITLE: Associations between Maternal Adverse Childhood Experiences, Executive Function, and Emotional Availability in Mother-Child Dyads

AUTHOR: Madeleine Harris, B.H.Sc.

SUPERVISOR: Dr. Andrea Gonzalez

PAGES: viii, 62

Lay Abstract

Adverse childhood experiences (ACEs), which are experiences of abuse, neglect, and household dysfunction, are risk factors for difficulties in parent-child relationships when individuals become parents themselves. In addition, ACEs are associated with deficits in higher-order cognitive abilities called executive functions (EF) in adulthood, which may also, in turn, compromise an individual's ability to provide sensitive and nurturing care to their children. The following thesis explores the collective relationships between maternal ACEs, maternal EF, and emotional availability during parent-child interactions in a community sample of mothers and their children, followed from toddlerhood (18-months postpartum) to preschool (60-months postpartum). Findings from this study demonstrate unique trajectories of maternal and child emotional availability during this period in development. Higher maternal ACEs were associated with decreased emotional availability during parent-child interactions at 18-months postpartum and this effect decreased overtime. Mothers with higher EF, and their children, demonstrated increased emotional availability across development. Maternal ACEs was not associated with maternal EF. Findings are relevant in informing the development and adaptation of timely and preventative parenting interventions.

Abstract

Maternal adverse childhood experiences (ACEs) are associated with difficulties in parent-child relationships, however, research to date has focused on cross-sectional associations. Parent and child behavior may be differently affected by ACEs as a child develops and caregiving demands change. Furthermore, poorer executive function (EF) is associated with both ACEs and problematic parenting processes, and may be one potential mechanism involved in the intergenerational transmission of ACEs. This study examined longitudinal associations between maternal ACEs, maternal EF, and patterns of change in maternal and child emotional availability (EA) using longitudinal multilevel modelling (MLM). Mother-child dyads (N = 114) were followed at five separate assessments over a 5-year period. Maternal ACEs were measured retrospectively at 3-months postpartum, maternal EF was assessed at 8-months, and mother-child interactions were videotaped at 18-, 36- and 60-months postpartum. Results revealed that maternal EA was stable, while child EA increased from 18- to 60-months postpartum. Maternal ACEs were negatively associated with maternal and child EA at 18-months postpartum and this effect decreased overtime. In contrast, there was a persistent, positive effect of maternal EF on EA trajectories. Maternal EF did not mediate the association between ACEs and EA. Findings also demonstrated significant within-dyad associations between maternal and child EA. These findings lead to a deeper understanding of the effects of maternal influences on parent-child relationships. We provide important evidence regarding the intergenerational transmission of ACEs, demonstrating that effects of maternal ACEs on parenting are not necessarily persistent. Findings also support sustained relations between maternal EF and maternal and child behavior across development, suggesting the utility of EF as an intervention target.

Key words: adverse childhood experiences, parenting, executive function, growth curves

Acknowledgements

First and foremost, I would like to express my sincerest thanks to my supervisor, Dr. Andrea Gonzalez for her unwavering guidance and patience over the years. I could not have asked for a more supportive and encouraging mentor and it has truly been an honour to work with her. Her passion for and dedication to her research program, her commitment to her students, and her work ethic are truly inspiring. I am so grateful for the opportunity to complete my Master's degree under her mentorship.

Second, thank you to my committee members, Dr. Iris Balodis and Dr. Melissa Kimber, for providing your time and expertise towards the completion of this thesis. I appreciate your thoughtful questions, ideas, and support throughout this process.

I am also incredibly grateful for Dr. Gonzalez's fantastic research team, and other collaborators, that I have had the pleasure of working with for the past three years. I am so fortunate to have worked in such a supportive, engaging, and enjoyable environment. Thank you for all for the advice, the laughs, and the friendships.

Thank you, also, to the families who participated in our study. This work would not have been possible without your time, trust and enthusiasm. Finally, I would also like to thank my friends and family for their endless support, love and encouragement.

Table of Contents

Preliminary Pages

List of Figures and Tables

Page

Introduction

Adverse Childhood Experiences

Adverse childhood experiences (ACEs) are a commonly used conceptualization of trauma that include experiences from when an individual was 18 years or younger. Typical assessments generally include three categories – childhood abuse (emotional, physical, and sexual), neglect (emotional and physical), and household dysfunction (exposure to domestic violence, household substance abuse, household mental illness, parental separation or divorce, and incarcerated household member; Felitti et al., 1998). Exposure to ACEs represents a major public health issue, with over half of Canadian adults reporting at least one ACE, and one-third having experienced two or more (McDonald & Tough, 2014). The long-term consequences of ACEs are well established, with a multitude of negative outcomes across the lifespan (Felitti et al., 1998; Kalmakis & Chandler, 2015). In particular, a recent meta-analysis demonstrates dose-response relationships between ACEs and a number of negative outcomes in adulthood, with individuals with four or more childhood stressors at a greater risk for risky health behaviours (OR = 3.6 – 10.2), increased rates of mental illness (OR = 3.7 – 4.4), and chronic disease (OR = 1.4 – 3.1; Hughes et al., 2017). Beyond health outcomes, other studies have supported the long-term effects of ACEs into adulthood including disrupted attachment and romantic relationships (McCarthy & Maughan, 2010; Murphy et al., 2014), increased risk of single parenthood and poverty (Lipman et al., 2001), and psychosocial difficulties during pregnancy, including adolescent pregnancy and decreased social support (Hillis et al., 2004; Racine et al., 2018). Of importance here is the impact of parental exposure to traumatic experiences on the next generation, thus leading to an 'intergenerational cycle' of risk. In particular, a growing body of literature has evaluated the downstream effects of parental ACEs on parent-child interactions (Chamberlain et al., 2019; Savage et al., 2019; Vaillancourt et al., 2017).

Maternal ACEs and Parent-Child Relationships

Exposure to ACEs increases parents' risk of maltreating their own child (Madigan et al., 2019), in addition to facing increased challenges in providing sensitive, responsive, and nurturing care to their children (Chamberlain et al., 2019; Savage et al., 2019; Vaillancourt et al., 2017). Previous research has found associations between maternal experiences of childhood adversity and a range of both self-reported and observational maladaptive parenting outcomes (Chung et al., 2009; Dubowitz et al., 2001; Iyengar et al., 2014; Kunseler et al., 2016; Lang et al., 2010; Lyons-Ruth & Block, 1996). Studies have demonstrated that mothers with a history of ACEs are more hostile (Rijlaarsdam et al., 2014), less responsive (Bert et al., 2009), and display decreased sensitivity (Pereira et al., 2012). Maternal ACEs have also been linked to impaired maternal-infant bonding (Lehnig et al., 2019; Muzik et al., 2013), increased parenting stress (Moe et al., 2018; Steele at al., 2016), use of authoritarian or permissive parenting behaviours (Leslie & Cook, 2015), and heightened maltreatment potential (Rodriguez & Tucker, 2011). Other studies have examined the effects of specific subtypes of childhood adversity, such as sexual abuse (DiLillo et al., 2000; Zvara et al., 2017), physical abuse (Milan et al., 2004), and exposure to parental violence (Waldman-Levi et al., 2015) with negative impacts on multiple domains of parenting including maternal sensitivity and parenting competence.

Several studies that have examined the association between maternal ACEs and parenting behavior have used the EA (Emotional Availability) Scales, a framework that assesses parent-child emotional exchanges through observations and ratings of dyadic interactions (Biringen et al., 2014; Biringen & Easterbrooks, 2012). Existing empirical research suggests that childhood trauma is associated with decreased sensitivity (Fuchs et al., 2015; Kluczniok et al., 2015; Mielke et al., 2016), increased intrusiveness (Moehler et al., 2007), and increased hostility (Pasalich et al., 2016), as measured by the EA Scales. For instance, Bailey and colleagues (2012) showed that mothers of 4-6-year-old children with experiences of emotional abuse, neglect, and witnessing family violence during childhood, display increased hostility. Further, mothers exposed to physical abuse are more likely to demonstrate less optimal structuring, decreased sensitivity, and increased hostility, in interactions with 18-month-old toddlers (Driscoll & Easterbrooks, 2007).

Taken together, these findings reveal several difficulties among caregivers with a history of childhood adversity. However, other studies report nonsignificant associations between maternal ACEs and later parenting behavior (Lange et al., 2019; Treat et al., 2017). For instance, recent findings demonstrate no association between maternal history of child maltreatment and observed hostile, controlling or positive parenting behaviours at 6-months postpartum (Sexton et al., 2017). Another study investigated the impact of maternal exposure to child maltreatment on observed maternal caregiving quality at 24- and 42-months postpartum, and found a nonsignificant effect (Bosquet Enlow et al., 2016). Importantly, the results of a recent meta-analysis, which averaged effects across 32 studies, demonstrated a small but significant association between maternal history of maltreatment and parenting behavior ($r = -.13$; Savage et al., 2019). This finding demonstrates that child adversity may be a risk factor for dysfunctional parenting behavior, however, variability in results across studies suggest that the strength of this relationship may be attributed to sample and study characteristics. For example, higher effect sizes were found in samples with a greater number of boys compared to girls, when parenting measures involved relationship-based or negative behaviors, and in older publications (Savage et al., 2019). Given variation in findings, it is clear that the relationship between maternal ACEs and parenting behavior is complex and not fully understood. Building on prior research, the current study aims to provide a more detailed understanding of these links by observing parent-child interactions at multiple time points across development, and by exploring maternal executive function (EF) as a novel, underlying mechanism that may be involved in this relationship.

Maternal ACEs and Parent-Child Relationships Across Time

While researchers have determined that a mother's ACEs can impact parenting behavior, current research has relied almost exclusively on cross-sectional data, focusing on parent-child interactions at a single time point. However, parenting may be differentially affected by maternal ACEs as a child ages and caregiving demands change. Longitudinal studies indicate moderate stability in parenting from infancy to early childhood (Else-Quest et al., 2011; Feldman, 2010; Pianta et al., 1989; Wang et al., 2013). Regarding developmental changes in EA, findings show both stability and decreases in maternal EA from infancy to preschool, while child EA consistently increases during this period (Matte-Gagné et al., 2018; Stack et al., 2019). There is also increasing interest in how the effects of contextual risk factors on parent-child relationships, such as maternal depression and cumulative risk, may vary or remain stable across development (Finegood et al., 2016; Matte-Gagné et al., 2018; Mitchell et al., 2019). To our knowledge, only one study to date has examined the impact of maternal ACEs on parenting behavior across multiple time points (Fuchs et al., 2015). Focusing on the first year postpartum, Fuchs and colleagues (2015) found that mothers with a history of maltreatment showed only very discrete differences in sensitivity at 5-months postpartum, compared to a comparison group. At 12-months, the comparison group demonstrated increased sensitivity, while the maltreated group did not improve in sensitivity, indicating a potential time dependent association between child maltreatment and parenting. These differential effects highlight the need to consider child developmental status to better understand the transmission process of ACEs. Currently, it is unknown how the associations between exposure to ACEs and parent-child interactions may change from toddlerhood (18-months) to preschool (60-months).

Associations between ACEs and caregiving behaviour may be most pronounced in early toddlerhood, in which toddlers have recently experienced the developmental milestone of locomotion, marking a hallmark period in gains in autonomy (Anderson et al., 2013). These changes can be challenging for parents, eliciting more irritation and hostility in interactions with their child (Bornstein et al., 2010). Challenges may be most pronounced in parents impacted by trauma, in which a sense of loss of control and helplessness may emerge (Bosquet Enlow et al., 2014; Fuchs et al., 2015; Möhler et al., 2001). In contrast, the risk for poor caregiving for maltreated mothers may increase from toddlerhood to preschool. As children struggle for more autonomy, make gains in motor and cognitive competence, and engage in more non-compliant behaviour, parents may utilize more frequent limit setting and negative, coercive behaviors with their children (Bradley et al., 2017; Pasalich et al., 2016). In sum, the effects of ACEs on parent-child interactions may change or persist across development. It is therefore important for research to examine data collected across multiple time points to parse transient from enduring effects, resulting from maternal childhood adversity.

Theoretical Perspectives

Several theoretical models have aimed to elucidate the mechanisms through which exposure to childhood adversity may impact later parenting behavior. According to social learning theory, parents replicate the behavior of their own parents (Bandura, 1973). Individuals exposed to traumatic childhood events, such as abusive and neglectful parenting, may repeat these learned behaviors in interactions with their own children (Pears & Capaldi, 2001). Another way to conceptualize these associations is through attachment theory, which suggests that early experiences with caregivers shape the development of internal working models of attachment, and guide expectations of future relationships (Ainsworth et al., 1978). Those who experience insensitive and inconsistent caregiving, as seen in cases of maltreatment and other forms of adversity, are more likely to develop insecure and disorganized attachment, and may have difficulty forming relationships with their own children (George & Solomon, 2008; Gonzalez et al., 2009).

Underlying parental psychosocial, emotional, and cognitive difficulties may also act as mechanisms of transmission in linking the distal relationships between childhood adversity and parent behavior. Many of the negative psychosocial circumstances associated with ACEs, including decreased social support, exposure to intimate partner violence, and higher rates of adolescent pregnancy, may also interfere with a parent's ability to provide optimal parenting (Ammerman et al., 2014; Barrett, 2010; Dixon et al., 2005; Madigan et al., 2014; Schuetze & Eiden, 2005; Shenk et al., 2017). Additionally, ACEs are associated with higher rates of psychopathology in adulthood, including depression and anxiety, symptoms of which are also associated with difficulties in parenting (Banyard et al., 2003; Madigan et al., 2015; Martinez-Torteya et al., 2014; Morelen et al., 2016; Roberts et al., 2004). Prior work has also examined the role of maternal stress physiology (Gonzalez et al., 2012; Juul et al., 2015), emotion regulation (Smith et al., 2014), and executive function (Gonzalez et al., 2012; Guss et al., 2018). In line with these findings, it is of interest to examine potential mediators underlying the associations between maternal ACEs and subsequent negative parenting practices.

Maternal Executive Function as a Mechanism

Parental EF has been recently recognized as a potential mechanism involved in the intergenerational transmission of early adversity (Lomanowska et al., 2017). Executive functions are higher-order cognitive abilities (e.g., working memory, inhibitory control, cognitive flexibility) that are primarily mediated by the pre-frontal cortex (PFC; Diamond, 2013; Miyake et al., 2000). These capacities govern goal-directed actions and adaptive responses to novel and complex situations and are critical to many aspects of daily functioning, as they help support decision-making, problem solving, planning, and abstract thinking (Crandall et al., 2015; Zelazo, 2015).

There is strong evidence that exposure to childhood adversity can impair EF development. Deficits exist across several EF domains, including working memory, attention, inhibition, and problem-solving, in children exposed to adverse events (Bos et al., 2009; De Bellis et al., 2013), with consequences lasting into adulthood (Navalta et al., 2006; Nikulina & Widom, 2013). Parental EF has also been found to play a key role in the caregiver-child relationship, given the complexity and challenges involved in parenting, such as recognizing and attending to a child's cues, using flexibility in behavior, and adapting to a child's needs (Crandall et al., 2015; Gonzalez et al., 2009). These cognitive capacities allow a mother to engage in behavior that is appropriate to the child's needs, regulate emotions in the face of stress, and balance interactions with their child within the context of competing stimuli and demands. In this regard, empirical findings have demonstrated links between parental EF and different domains of parenting behavior (Bridgett et al., 2017; Cuevas et al., 2014; Deater-Deckard & Bell, 2017; Deater-Deckard et al., 2012; Deater-Deckard et al., 2010; Sturge-Apple et al., 2014; Suor et al., 2017). Specifically, findings indicate that mothers with low inhibitory control use harsh discipline (Sturge-Apple et al., 2017) and engage in less sensitive and responsive parenting behaviors (Musser et al., 2012; Shaffer & Obradović, 2017). Similarly, cognitive flexibility is associated with higher sensitivity during parent-child interactions (Chico et al., 2014).

While EF impairment has been linked to both early adversity and difficulties in parent-child relationships, these associations have rarely been studied simultaneously. Recent research has recognized EF as a potential mediator in the relationship between maternal ACEs and caregiving behavior (Guss et al., 2018). For instance, in a community sample of women within the first year postpartum, Gonzalez et al. (2012) found maternal working memory mediated relations between early life adversity and maternal sensitivity. Given this evidence, maternal EF is a likely mechanism in explaining the distal links between ACEs and parenting. However, no research to date has examined maternal EF as a mediator in the association between maternal ACEs and parent-child interactions across development.

Current Study

Using a longitudinal design, the current study fills an important gap in the literature by examining the collective relationships among maternal ACEs, maternal EF, and maternal and child EA from toddlerhood to preschool. While the association between ACEs and EA has been demonstrated in cross-sectional studies, less is known about how this association may change across child development. Furthermore, studies examining the relations between ACEs and EA have focused on maternal EA. Parent-child interactions are inherently dyadic in nature, with children signalling their emotional states and needs to their parents while parents reciprocate though supportive and positive exchanges (Bornstein et al., 2010; Newton et al., 2014). Given these bidirectional relationships, a child's emotional and social responsiveness to their mother is likely similarly affected by maternal ACEs. For this reason, it is important to examine child EA, as both an outcome of maternal exposure to child adversity, and to build on prior longitudinal research that has examined bidirectional associations between maternal and child EA (Matte-Gagné et al., 2018; Stack et al., 2019).

Thus, the objectives of the current study are to: (1) model developmental trajectories of maternal and child EA from child age 18- to 60-months postpartum; (2) examine the effects of maternal ACEs on these trajectories, and determine whether exposure to ACEs has differential effects on the caregiving context from toddlerhood (18-months) to preschool (60-months); (3) test the role of maternal EF as a mediator in the association between ACEs and EA; and (4) examine the within-dyad covariation between maternal and child EA across development. A better understanding of the potential time-dependent effects of, and underlying mechanisms involved in, the associations between ACEs and parent and child outcomes is critical so both timely and preventative interventions can be appropriately developed and adapted to optimize outcomes for those affected by childhood adversity, and ultimately prevent the intergenerational cycle of ACEs.

Methods

Participants

Participants were enrolled in a larger longitudinal research study examining the impact of maternal cognitive function on parenting practices and infant cognitive and emotional development. Mother-infant dyads were recruited in person at the maternity ward at St. Joseph's Healthcare, Hamilton, Ontario. Study inclusion criteria for mothers were as follows: (a) age 18-years or older at time of birth; (b) gave birth to a full-term, healthy infant; (c) able to access their infants at the time of the home visits; and (d) able to read, write, and speak English. Exclusion criteria included any barriers to completion of research measures (e.g., severe disability, language barriers). The study protocol was approved by the McMaster Research Ethics Board and the St. Joseph's Healthcare Hamilton Research Ethics Board. Data collection occurred from May 2011 to January 2018, at five home visits when parents were approximately 3- (n = 141), 8- (n = 139), 18- (n = 108), 36- (n = 96), and 60-months (n = 91) postpartum.

Participants included in analysis were 114 mothers and their children. The sample represents a relatively low sociodemographic risk population of mothers and children (Table 1). At baseline, mothers ranged in age from 19 to 43 years (M = 31.31, SD = 5.18). Most mothers were highly educated, with 32.5% reporting university level training, 32.5% with a college education, and 23.7% with post-graduate training. Moreover, most mothers were either married (75.5%) or living common law (17.0%), while the remainder identified as being single (3.8%) or separated (3.8%). The majority of mothers in the study were Caucasian (87.6%), with 12.4% representing the 'other' ethnic groups. The median household income range was between $80,000-112,999 Canadian dollars. Overall, 68.5% of mothers reported experiencing at least one ACE, while 8.3% of these mothers experienced four or more ACEs. Mean child age at each visit were 4.03 (SD = 1.28), 8.62 (SD = .94), 19.28 (SD = 1.32), 39.79 (SD = 1.22), and 61.81 (SD = 2.17) months, respectively; 54.4% of children were female.

Table 1. Participant characteristics.

Characteristic	%
ACEs	
0	31.5
1	36.1
2	14.8
3	9.3
≥4	8.3
Ethnicity	
Caucasian	87.6
Other	12.4
Marital status	
Married	75.5
Living common law	17.0
Single	3.8
Separated or divorced	3.8
Educational level	
Primary	0.9
Secondary school	10.5
College	32.5
University	32.5
Post-graduate	23.7
Household income	
<$20,000	8.8
$20,000-54,999	8.8
$55,000-79,000	27.5
$80,000-112,999	20.6
$113,000-161,999	23.5
$162,000+	10.8
Child sex	
Female	54.4
Male	45.6
Maternal age (*M*, *SD*)	31.31 (5.18)

Procedure

At each time point, mother and child participants participated in a 2-hour home visit completed by two trained female research assistants. At the 3-month home visit, written consent was obtained and mothers completed two self-report measures of ACEs.

At the 8-month visit, a series of behavioral assessments of EF were completed by the mother. At the 18-, 36- and 60-month visits, mother-child interactions were videotaped and mothers reported on their depressive symptoms.

During the 18-month visit, mothers were asked to play with their infant as they normally would for 5 minutes. For the next 5 minutes, mothers were given a standardized set of toys to use. Mothers were then asked to complete a short questionnaire while their infants were still present for approximately 10 minutes (divided attention task). At the 36-month visit, mothers were again asked to play as they normally would with their child (4 minutes), and were then asked to complete a challenging, problem-solving puzzle task together for 4 minutes. Mothers were asked to complete a short questionnaire for the last 4 minutes of the interaction (divided attention task). During the 60-month assessment, mothers and children engaged in a 5-minute free play interaction and then participated in a structured Etch-a-Sketch task (Stevenson-Hinde & Shouldice, 1995). Mothers and their children were each assigned a knob and instructed to draw two pictures given to them using the etch-a-sketch: two stacked rectangles (practice trial) and a house (test trial). There was no set time for completion.

Measures

Adverse Childhood Experiences

Childhood Trauma Questionnaire. The Childhood Trauma Questionnaire (CTQ; Bernstein & Fink, 1998) is a 28-item self-report questionnaire that evaluates the frequency of five types of maltreatment, including emotional, physical and sexual abuse, and emotional and physical neglect. Responses are based on a 5-item Likert scale ranging from 1 (Never True) to 5 (Very Often True), with higher total scores indicating greater severity of trauma exposure in childhood and adolescence. Cut-off scores have been determined to define the severity of maltreatment experience, ranging from none to low, moderate or severe. The CTQ has established good internal reliability in community samples (α = .96; Paivio & Cramer, 2004; α = .91; Scher et al., 2001). Adequate test-retest reliability has also been shown over an 8-10-week period (r = .85; Paivio & Cramer, 2004). In the present sample, the questionnaire demonstrated high internal consistency (Cronbach's α =.91).

National Comorbidity Survey Replication (NCS-R). The National Comorbidity Survey is a nationally representative survey measuring events of psychological distress during childhood (Kessler et al., 2004). Specifically, participants completed a subset of questions from Section 37 of the NCS-R. Two items in this section assessed childhood exposure to parental separation or divorce and 12 items assessed exposure to parental mental illness (e.g., anxiety, depression).

Previous research has used the ACE Study Questionnaire to assess exposure to adverse childhood events (Dube et al., 2003; Felitti et al., 1998). The current study created a summary measure assessing childhood exposure to seven adverse childhood events: three subtypes of abuse (physical, emotional, and sexual), two subtypes of neglect (physical and emotional), and two subtypes of household dysfunction (parental separation/divorce and parental mental illness). Participants received a score of "1" based on low-to-moderate cut-offs from the CTQ (Bernstein & Fink, 1998) and positive screens from the NCS-R (i.e., if respondents indicated "yes" to parental separation or divorce during childhood, or if respondents indicated “yes” to their mother or father experiencing symptoms of anxiety or depression during childhood; Kessler et al., 2004). A score for ACEs was created by summing responses, with scores ranging from 0 to 7.

Mother-Child Interactions

Emotional Availability Scales. Mother-infant interactions were assessed using the Emotional Availability (EA) Scales, 4th Edition (Biringen et al., 2014), an internationally established assessment that examines the quality of caregiver–child relationships. The EA Scales focus on the emotional exchange between caregiver and child and their ‘attunement’ to each other’s needs and goals (Biringen & Easterbrooks, 2012). This framework assesses several dimensions of caregiver-child interactions, including four caregiver dimensions: sensitivity, structuring, nonintrusiveness, and nonhostility, and two child dimensions: child responsiveness and child involvement. Sensitivity refers to a parent’s appropriate and positive affective exchanges, as well as their perceptions of and responsiveness to their child’s emotions and cues. Structuring assesses the ability of a parent to adequately guide and scaffold the child’s play, while supporting the child’s autonomy and setting limits as needed. Nonintrusiveness refers to the ability to be available to the child without undermining their autonomy, and includes the absence of qualities such as over-direction, interference or overprotection. The final caregiver dimension is nonhostility, which is characterized by a lack of anger, impatience, dissatisfaction, or other concealed or open forms of hostility exhibited in the parent’s facial expressions or voice. The first child dimension, child responsiveness, refers to the child’s behavioral and emotional responsiveness to their caregiver, as well as the ability to demonstrate a healthy and positive affect. Child involvement refers to the child's demonstration of initiative and interest in including the adult in the interaction. All scales are continuous and range from 1 to 7. For all, higher values indicate higher EA. The EA scales have been validated within a broad spectrum of contexts, including samples with children ranging from infancy to middle childhood, within low and high-risk community populations and clinical samples, and across a wide variety of cultural settings (Biringen et al., 2014).

EA was coded independently by four trained coders that had been certified as reliable coders by Zeynep Biringen after an extensive training period. Coders were blind to background information of the dyad. Good interrater reliability was established for 10% of the videotapes ($N = 11$, 10 and 9 for visits at 18-, 36- and 60-months, respectively). Intraclass correlation coefficients (ICCs) for pairs of raters before discrepancy resolution ranged between .75 to .77 at 18-months, .75 to .85 for 36-months and .79 to .81 for 60-months. Correlations between subscales were positively and significantly correlated for maternal ($r > .35$) and child EA ($r > .81$). Therefore, a mean total score for maternal (mean of 4 subscales) and child EA (mean of 2 subscales) was computed for each time point.

Maternal Executive Function

Wisconsin Card Sorting Task. The Wisconsin Card Sorting Task (WCST; Grant & Berg, 1948), a measure of cognitive flexibility, requires participants to match a series of target cards with one of four stimulus cards based on various dimensions (i.e., colour, shape). Each target card contains one of four shapes (i.e., stars, crosses, triangles, or circle) in one of four colours (i.e., red, green, yellow, or blue). At the beginning of the task, four stimulus cards are presented and the examinee must place each consecutive target card in front of the stimulus card that it appears to match best. Participants are not informed of sorting principles, which change without warning, and participants have to infer the new rule based on feedback after each response regarding correct vs. incorrect responses (Grant & Berg, 1948). Performance on this task was indexed by the number of perseverative errors (PE) scaled score, which represents the number of times participants failed to change sorting principles even after receiving feedback indicating that the rule was no longer correct.

D-KEFS Color-Word Interference Test. The D-KEFS Color-Word Interference Test (CWIT) is a variation of the Stroop Test (Stroop, 1935) and assesses inhibitory control and cognitive flexibility. The test consists of four conditions (Delis et al., 2001a). First, participants are presented with a page containing a series of coloured squares (i.e., red, green, yellow, and blue) and are asked to say the names of the colors (colour naming trial). Next, participants are presented with a page containing the words of colours (i.e., “red”, “green”, and “blue”) displayed in black ink and asked to read the words aloud (word reading trial). These two conditions provide a baseline measure of reading performance. Participants are then presented with a page containing the colour words (i.e., “red”, “green”, and “blue”) printed incongruently in red, green, or blue ink. The participant is asked to say the colour of the ink each word is printed in (inhibition trial). In the last condition, participants are presented with a page containing the colour words (i.e., “red”, “green”, and “blue”) which are written in incongruent red, green, or blue ink. Half of these colour words are enclosed within boxes. The participant is asked to read aloud the colour of the ink in which each word is printed (as in the third trial), but to read the word aloud itself when a word appears enclosed in a box (inhibition/switching trial). Performance for the CWIT is assessed based on completion time, which is the number of seconds that the participant takes to complete each condition (Delis et al., 2001b). For the current study, completion time scaled scores for condition 3 (inhibition) and condition 4 (inhibition/switching) were used in analyses.

A single composite of maternal EF was formed by standardizing and then averaging test indices (i.e., WCST PE scaled score and CWIT conditions 3 and 4 completion time scaled score). These outcomes were selected based on their demonstrated reliability and validity, and frequent use in the current literature. PE are one of the most commonly reported outcomes for the WCST (Rhodes, 2004) and likely reflect specific deficits in processing feedback, cognitive flexibility, and attentional control (Demakis, 2003; Drewe, 1974; Gläscher et al., 2019). Likewise, completion time scores are the primary performance measure of the CWIT (Berg et al., 2016), and have been associated with decreased medial frontal gyrus volume (Adólfsdóttir et al., 2014). Previous research has also demonstrated significant relations between these outcomes and parenting behavior (Azar et al., 2017; Bridgett et al. 2017; Deater-Deckard & Bell, 2017).

Covariates

Covariates included a composite of SES, which was created by summing standardized variables of household income and mother's highest completed education ($r = .34$, $p < .0001$), and child sex (coded as 1 = male and 0 = female). Maternal depressive symptoms were also controlled for, measured using the Center for Epidemiological Studies Depression Scale (CES-D), a 20-item self-report questionnaire that assesses the frequency of depressive symptomatology in the past 7 days (Radloff, 1977). Participants rate their responses on a four-point Likert scale (0 = "rarely or none of the time" to 3 = "most or all of the time"). A cut-off score of greater or equal to 16 indicates clinically significant levels of depression. The CES-D has demonstrated strong psychometric properties in various demographic groups, including community samples, psychiatric populations, and postpartum mothers (Weinberg et al., 2001; Weissman et al., 1977). Adequate test-retest reliability has also been demonstrated, with scores ranging from .51 to .67 over a two- to eight-week period and from .32 to .54 over a three- to 12-month period (Radloff, 1977). In the present sample, the questionnaire demonstrated high internal consistency at each time point (.88 ≥ Cronbach's α ≤ .91).

Missing Data

Data included in the current study were collected across multiple time points over the course of five years. Parent-child interaction data missing at all three time points were excluded from the analysis sample. Therefore, participants included in analysis were 114 mothers and their children. To assess possible differences between participants included in the analysis and those not, independent samples t-tests and chi-square tests were run. We examined several variables for which we had complete information collected at 3-months postpartum, including maternal ACEs, maternal depressive symptoms, maternal age, and maternal education. Results indicated no significant differences between participants retained and those excluded from the sample.

For participants included in the analysis sample, 67% have parent-child interaction data for all three visits, 19% of participants have data from two time points, and 13% have parent-child interaction data at one time point. Participants that completed a home visit at all three time points did not significantly differ from those that did not in variables including maternal ACEs, maternal depressive symptoms, maternal EF, maternal age, maternal education, and household income. In terms of wave-level missingness, missing data ranged from 0% to 19.4% for main study variables. Full-information maximum likelihood (FIML) estimation was used to account for missing data (Enders, 2010).

Statistical Analysis

Descriptive analyses and bivariate correlations were examined for all study variables. Longitudinal multilevel modeling (MLM) was used to examine the effects of maternal ACEs and maternal EF on trajectories of maternal and child EA from 18- to 60-months postpartum. Growth curves were fitted in Mplus 8 software (Muthén & Muthén, 1998–2017). MLM treats repeated observations as nested within individuals and estimates patterns of change overtime on two levels: a Level 1 component representing change across time within individuals, and a Level 2 component representing how patterns of change differ across individuals (Singer & Willett, 2003). Both fixed (i.e., average) and random (i.e., variability) effects are estimated. MLM allows for the inclusion of time-variant (i.e., variables that change and are measured repeatedly across time) and time-invariant predictors (i.e., variables that do not vary over time). MLM has several advantages for measuring longitudinal change, including its ability to handle relatively small sample sizes (Curran et al., 2010; Maas & Hox, 2005) and unbalanced data (i.e., the number of home visits varies across families in the sample; Singer & Willett, 2003).

Growth curves were modelled separately for maternal and child EA. The time variable corresponded to child age, in months. Observations at child age 18-, 36- and 60-months were coded as 0-, 18- and 42-months respectively to set the starting point of the analysis to zero. Therefore, the intercept represents EA at 18-months postpartum. Time-invariant predictors were grand-mean centered (i.e., intercept represents the estimated initial status for an individual with an average value for that predictor) and entered at Level 2. Time-variant predictors were entered as person-mean centered predictors at Level 1 (Singer & Willett, 2003).

As recommended by published guidelines (Singer & Willett, 2003), a step-wise procedure was employed. Consistent with the first objective, unconditional growth models, including both fixed and random linear time effects, were run to examine developmental patterns of change in EA and identify significant variance in intercept and slope (Model A). If random effects were insignificant, terms were deleted from subsequent models in order to provide a more parsimonious representation of findings (Bates et al., 2015; Matuschek et al., 2017; Raudenbush & Bryk, 2002; Singer & Willett, 2003). Next, a series of conditional growth models were estimated to examine the effects of study predictors on intercept and slope of EA. Maternal ACEs was added first to examine its effects on the intercept, as well as an interaction term with child age to examine its effects on EA overtime (Model B). Second, a term for maternal EF was added; association with intercept (i.e., EA at 18-months) and interaction with child age, to assess effects on EA overtime, were examined (Model C). In a next step, covariates (maternal depression, family SES, child sex) were added to the model to account for their confounding effects (Model D). Model D was then run with time re-centered on the second (36-months) and final age of assessment (60-months) to examine persistence of, or changes in, the strength and/or direction of the effects of maternal ACEs and maternal EF on EA from toddlerhood to preschool. Finally, child EA was added as a time-variant predictor in the growth model of maternal EA (and the reverse model was examined as well) to explore the longitudinal within-dyad associations between maternal and child EA (Model E). Model fit was assessed by comparing Bayesian information criterion (BIC) and Akaike's information criterion (AIC) values between models, with lower values indicative of better fit.

Results

Descriptive Statistics and Associations Among Study Variables

Descriptive statistics for study variables, including means and standard deviations, are reported in Table 2. Bivariate correlations are presented in Table 3. There was a significant negative association between maternal ACEs and maternal and child EA, and a significant positive association between maternal EF and maternal and child EA. There was no correlation between maternal ACEs and maternal EF.

Table 2. Descriptives of analysis variables.

	18-months			36-months			60-months		
Time-variant	N	Mean	SD	N	Mean	SD	N	Mean	SD
Maternal EA	108	5.24	.84	96	5.29	.87	85	5.24	.60
Child EA	108	4.83	1.24	96	5.22	1.06	85	5.21	.65
Maternal Depression	107	7.82	8.02	96	8.77	9.21	90	7.92	8.17
Time-invariant	N	Mean	SD						
Maternal EF	112	.04	.75						
SES	102	.06	1.68						

Table 3. Bivariate correlations among study variables.

Variables	1	2	3	4	5	6	7	8
1 Maternal ACEs	--							
2 Maternal EF	.07	--						
3 Maternal EA	-.20**	.23**	--					
4 Child EA	-.20**	.21**	.70**	--				
5 Child Age	.00	.00	-.001	.15*	--			
6 Maternal Depression	.34**	.02	-.16**	-.16**	.003	--		
7 Family SES	-.16**	-.01	.32**	.26**	.00	-.29**	--	
8 Child Sex	-.003	.03	.05	.10t	.00	-.09	.10t	--

t$p < .10$, *$p < .05$, **$p < .01$

Maternal EA Growth Curves

The unconditional growth model indicates no evidence of a significant fixed slope, suggesting that on average, maternal EA was stable from 18- to 60-months postpartum (see Table 4, Model A). When the time variable was included as a random slope, the variance estimate was small and non-significant, and this term was deleted from the model. The intercept of maternal EA was significant ($B = 5.26$, $p < .001$). Random intercepts were retained and indicated a significant amount of between-person variation in maternal EA at 18-months postpartum ($\sigma^2 = .32$, $p < .001$).

Maternal ACEs was first entered into the growth model of maternal EA. Results indicated that ACEs had a significant negative effect on intercept ($B = -.17$, $p < .001$); mothers with greater exposure to ACEs demonstrated lower EA at 18-months postpartum (see Table 4, Model B). In contrast, ACEs had a significant positive effect on slope ($B = .003$, $p < .05$), indicating a significant interaction between maternal ACEs and child age, such that the association between ACEs and maternal EA decreased from toddlerhood to preschool. As shown in Table 4, Model C, maternal EF was significantly associated with intercept ($B = .30$, $p < .05$); mothers with higher EF demonstrated higher EA at 18-months postpartum. Maternal EF was not associated with slope of maternal EA, indicating effects were stable across development. Of note, the addition of maternal EF did not decrease the coefficient for ACEs from what it was in Model B, indicating that maternal EF did not mediate the association between maternal ACEs and EA. The main effects of maternal ACEs and EF remained significant after covariates were added, and after accounting for the significant effects of SES on intercept ($B = .15$, $p < .001$; see Table 4, Model D).

Table 4. Maternal EA growth curves.

Parameter	Model A	Model B	Model C	Model D
Fixed Effects B *(SE)*				
Intercept	5.26 (.08)***	5.26 (.10)***	5.29 (.07)***	5.27 (.07)***
Slope	-.002 (.002)	-.002 (.002)	-.002 (.002)	-.003 (.002)
ACE score		-.17 (.05)***	-.20 (.05)***	-.15 (.05)**
Maternal EF			.30 (.11)*	.26 (.11)*
Maternal Depression (t)				-.002 (.01)
SES				.15 (.04)***
Child Sex				.01 (.13)
ACE score X time		.003 (.001)*	.004 (.001)**	.003 (.001)*
Maternal EF X time			-.002 (.003)	-.001 (.003)
Random Effects σ^2 *(SE)*				
Residual	.30 (.03)***	.29 (.04)***	.29 (.04)***	.28 (.04)***
Intercept	.32 (.07)***	.30 (.07)***	.24 (.06)***	.21 (.05)***
AIC	645.77	610.38	591.72	538.77
BIC	660.43	632.10	620.62	577.60

$^t p < .10$, $*p < .05$, $**p < .01$, $***p < .001$
t = time-variant predictor

Given the significant positive association between maternal ACEs and slope of maternal EA, time was re-centered to the 36- and 60-month visits to examine how this association changed overtime. Findings revealed that the effects of ACEs on intercept were smaller in magnitude at 36-months (B = -.10, p < .01) and insignificant at 60-months (not shown in Table 4). Figure 1 displays the moderating effect of child age on the association between ACEs and maternal EA. In contrast, the effects of maternal EF on maternal EA persisted overtime (i.e., association remained significant and of similar magnitude at 36- and 60-months postpartum).

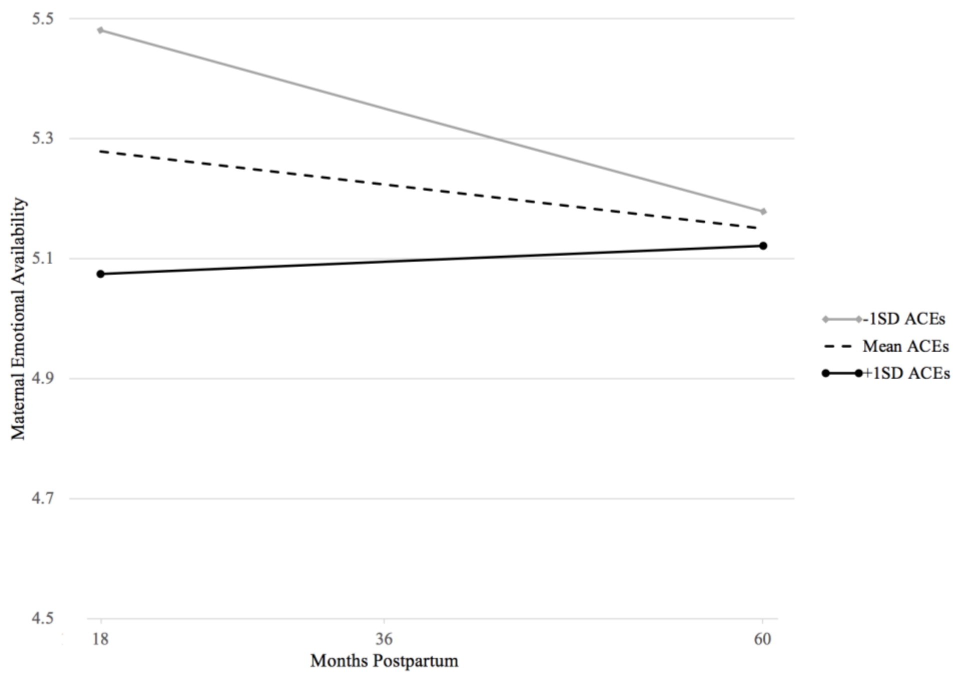

Figure 1. Child age moderates the relation between maternal ACEs and maternal EA. Mothers with exposure to a greater number of ACEs demonstrated lower EA, whereas mothers with a lower ACE score displayed higher EA, at 18-months postpartum. There was no significant effect of maternal ACEs on maternal EA at 60-months.

Child EA Growth Curves

In the unconditional growth model, there was a significant positive fixed slope (B = .01, $p < .01$), indicating a significant increase in child EA, on average, from ages 18- to 60-months (see Table 5, Model A). The inclusion of a term for random slope was small and non-significant, and this term was deleted from the model. The initial status of child EA was also significant ($B = 4.91$, $p < .001$). Random intercepts were retained and indicated a significant amount of between-person variation in child EA at 18-months postpartum ($\sigma_2 = .32$, $p < .001$).

Maternal ACEs was negatively associated with intercept (B = -.23, $p < .01$); children of mothers exposed to a greater number of ACEs demonstrated lower EA at child age 18-months (see Table 5, Model B). Maternal ACEs was positively associated with slope (B = .005, $p < .05$) of child EA, indicating that this association decreased from 18- to 60-months. When maternal EF was added to the model, results showed significant positive effects of EF on intercept (B =.32, $p < .05$); children of mothers with higher EF demonstrated higher EA at 18-months postpartum (see Table 5, Model C). Maternal EF did not interact with time, indicating that this association remained stable across development. The addition of maternal EF did not decrease the coefficient for ACEs from what it was in Table 5, Model B, indicating no evidence of mediation through maternal EF. As seen in Table 5, Model D, adjusted effects of ACEs on intercept and slope were significant, while the effects of maternal EF on intercept approached significance (p = .052), when covariates were included. SES was the only covariate with significant effects on intercept of child EA (B = .15, $p < .001$).

Table 5. Child EA growth curves.

Parameter	Model A	Model B	Model C	Model D
Fixed Effects B *(SE)*				
Intercept	4.91 (.11)***	4.92 (.11)***	4.93 (.11)***	4.90 (.10)***
Slope	.01 (.003)**	.01 (.003)**	.01 (.003)*	.01 (.003)*
ACE score		-.23 (.07)**	-.25 (.07)***	-.21 (.07)**
Maternal EF			.32 (.16)*	.28 (.15)t
Maternal Depression (t)				.01 (.01)
SES				.15 (.04)***
Child Sex				.12 (.15)
Child EA (t)				
ACE score X time		.005 (.002)*	.005 (.002)*	.004 (.002)*
Maternal EF X time			.000 (.004)	.002 (.004)
Random Effects σ^2 *(SE)*				
Residual	.77 (.09)***	.78 (.09)***	.79 (.09)***	.67 (.08)***
Intercept	.32 (.10)***	.29 (.10)***	.22 (.09)**	.19 (.08)*
AIC	840.76	802.97	791.36	730.07
BIC	855.43	824.69	820.26	768.89

t$p < .10$, *$p < .05$, **$p < .01$, ***$p < .001$
t = time-variant predictor

The intercept of time was re-centered to the 36- and 60-month visits to see how the association between maternal ACEs and child EA changed overtime. Effects of maternal ACEs on intercept were smaller at 36-months ($B = -.14$, $p < .05$) and insignificant at 60-months (not shown in Table 4), indicating that, like maternal EA, the association between ACEs and child EA decreased overtime. The association between maternal ACEs and slope of child EA is displayed in Figure 2. Of note, the effects of maternal EF on child EA persisted overtime (i.e., no association with slope; significant effects at 36- and 60-months postpartum).

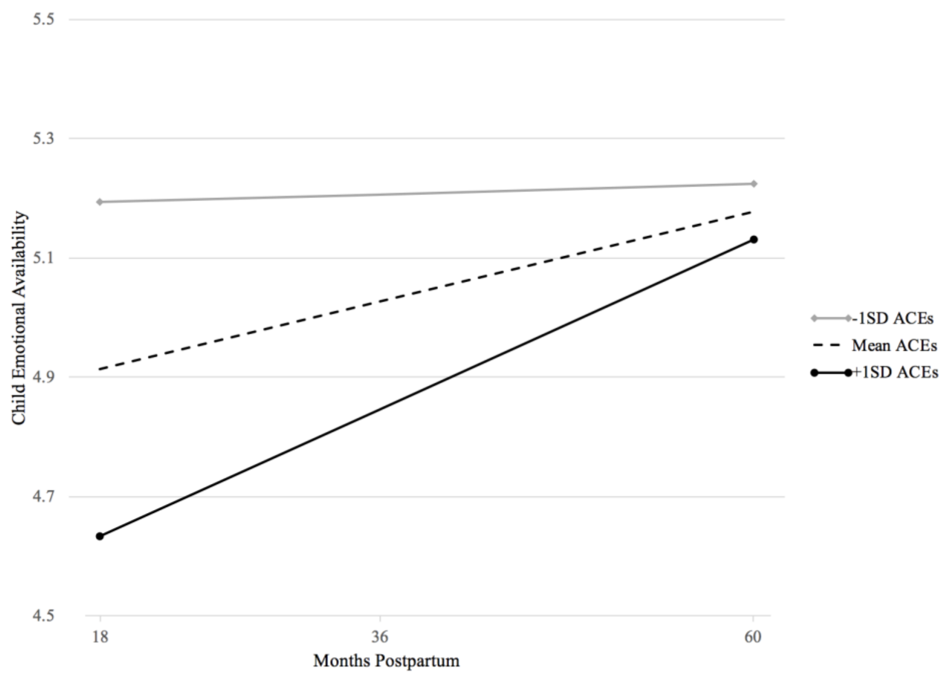

Figure 2. Child age moderates the relation between maternal ACEs and child EA. Children of mothers exposed to a greater number of ACEs demonstrated lower EA, whereas children of mothers with a lower ACE score displayed higher EA, at 18-months postpartum. There was no significant effect of maternal ACEs on child EA at 60-months.

Within-Dyad Covariation Across Time

As a last step, to examine the within-dyad covariation between maternal and child EA, child EA was included as a time-variant predictor of maternal EA, and vice versa (see Table 6). Intraindividual variation in child EA across time was found to be a significant predictor of intraindividual variation in maternal EA across development (B =.44, $p < .001$), meaning higher levels of child EA at one time point predicted higher maternal EA at the same time point. Likewise, intraindividual variation in maternal EA across time was found to be a significant predictor of intraindividual variation in child EA (B = 1.10, $p < .001$).

Table 6. Within-dyad associations between maternal and child EA.

Parameter	**Maternal EA**	**Child EA**
Fixed Effects B *(SE)*		
Intercept	5.30 (.07)***	4.83 (.10)***
Slope	-.01 (.002)**	.01 (.003)*
ACE score	-.12 (.04)**	-.14 (.07)*
Maternal EF	.27 (.10)*	.25 (.14)t
Maternal Depression (t)	-.01 (.04)	.01 (.01)
SES	.14 (.04)***	.15 (.04)***
Child Sex	.001 (.13)	.14 (.16)
Maternal/Child EA (t)	.44 (.04)***	1.10 (.11)***
ACE score X time	.001 (.001).	.001 (.002)
Maternal EF X time	-.002 (.002)	.003 (.003)
Random Effects σ^2 *(SE)*		
Residual	.28 (.04)***	.39 (.05)***
Intercept	.21 (.05)***	.39 (.08)***
AIC	538.77	639.47
BIC	577.60	681.82

t$p < .10$, *$p < .05$, **$p < .01$, ***$p < .001$
t = time-variant predictor

Discussion

To our knowledge, this is the first study to investigate longitudinal associations between maternal ACEs, maternal EF, and maternal and child EA in a community sample of mothers and children from 18- to 60-months postpartum. Overall, maternal ACEs and maternal EF are differentially associated with maternal and child EA across development.

Mothers and children demonstrated unique trajectories of EA from toddlerhood to preschool. Overall, maternal EA was stable from 18- to 60-months postpartum, which is consistent with emerging longitudinal research demonstrating that parenting behaviors, including sensitivity, intrusiveness, and structuring, are relatively stable from infancy to early childhood (Else-Quest et al., 2011; Feldman, 2010; Finegood et al., 2016; Matte-Gagné et al., 2018). In contrast, child EA increased from toddlerhood to preschool age. This finding supports and extends prior research that has shown increases in child EA during this developmental period (Matte-Gagné et al., 2018; Stack et al., 2019), and is likely indicative of increases in cognitive and social capacities of children, and, in turn, an enhanced ability to involve the mother and engage in active participation in the interaction (Bornstein et al., 2010; Cox et al., 2010). Additionally, our analyses demonstrated significant within-dyad covariation between maternal and child EA; mothers were more likely to be emotionally available if their child demonstrated higher emotional availability at the same time point, and vice-versa. This finding provides support for the notion of a reciprocal relationship between maternal and child EA, consistent with the dyadic nature of the EA scales (Biringen et al., 2014), and indicates that these bidirectional relations between mothers and children are persistent across toddlerhood and the preschool period. This has implications for intervention efforts; programs targeting the EA of one partner may improve the EA of the other partner of the dyad.

Our results revealed that maternal ACEs were associated with lower maternal and child EA at 18-months postpartum, a finding consistent with prior research that has found significant associations between ACEs and parenting behavior during toddlerhood, including maternal sensitivity (Dayton et al., 2016; Pereira et al., 2012) and responsive parenting (Madigan et al., 2015). Findings suggest that maternal ACEs are a potential risk factor for impaired parent-child relationships, however, this association decreased in strength overtime; ACEs were not significantly associated with maternal or child EA at 5-years postpartum. Importantly, while previous research has demonstrated an increasing association between maternal exposure to child maltreatment and maternal sensitivity from infant age 5- and 12-months (Fuchs et al., 2015), this study is the first to examine how maternal ACEs differentially influence parent-child interactions from toddlerhood to preschool.

It may be the case that challenging child behavior at 18-months, marked by increased locomotion and agency of the toddler (Anderson et al., 2013), presents a greater challenge to mothers that have experienced child adversity. A sense of loss of control might emerge in interactions, and the mother may experience again her own helplessness and victimization experienced as a child (Bosquet Enlow et al., 2014; Fuchs et al., 2015; Möhler et al., 2001). Challenging behavior during this stage may also elicit harsher, less sensitive parenting (Bornstein et al., 2010), ultimately interfering with the development of a healthy, dyadic emotional connection. The association between maternal ACEs and EA may then decrease as children get older because mutual EA is easier to maintain; older children and mothers know and have accommodated to one another better (Bornstein et al., 2010), and children develop increasingly sophisticated relationship skills, verbal abilities, and self-regulatory capacities (Campbell, 2002; Cox et al., 2010). In addition, our sample was a relatively low-risk community sample (i.e., mostly married/partnered, highly educated). Previous research has demonstrated that protective demographic factors influence the extent to which parent-child relationships are affected by ACEs. For example, social support moderates the relation between childhood neglect and maternal empathy (Bartlett & Easterbrooks, 2015). Furthermore, safe, stable, and nurturing relationships, such as a supportive romantic partner (Labella et al., 2019; Schofield et al., 2013), and financial stability (Dixon et al., 2008) are protective factors in the intergenerational transmission of ACEs. Therefore, a positive emotional connection between the mother and child may be easier to maintain within the context of proximal demographic factors present in this sample.

Taken together, the decreasing association between maternal ACEs and maternal and child EA across development may be attributed to increased verbal and socioemotional capacities of older children (Campbell, 2002; Cox et al., 2010), in addition to protective factors that may mitigate the effects of ACEs, such as financial stability and the presence of a supportive partner. As such, a better understanding of moderating processes that may be involved in the intergenerational transmission of ACEs, including child age and various protective factors, is needed. Additional research should examine these longitudinal associations in higher-risk and clinical samples, where there is likely a higher severity of ACEs and the quality of the family environment may be lower.

Higher maternal EF, specifically a composite of cognitive flexibility and inhibitory control, predicted increased maternal and child EA. This study is the first to examine the persistence of effects of maternal EF on parent-child interactions at multiple time points across development. We found that maternal EF plays an important and stable role in EA from toddlerhood to preschool. This is consistent with a growing body of empirical evidence demonstrating links between maternal cognitive flexibility and inhibition, and parenting behavior, including maternal sensitivity, responsiveness, and use of harsh discipline, across a range of child ages (Chico et al., 2014; Cuevas et al., 2014; Musser et al., 2012; Shaffer & Obradović, 2017; Sturge-Apple et al., 2017). Maternal EF may provide important foundational skills for caregiving behavior, allowing mothers to adapt and sensitively respond to child behavior across various developmental stages.

Our findings demonstrate that cognitive flexibility and inhibitory control are important predictors of maternal and child EA. Cognitive flexibility, the capacity to flexibly adapt behavior (Diamond, 2013), is related to a mother's ability to recognize and attend to their child's cues, change strategies, and switch attention between different situational demands (Gonzalez et al., 2009). Inhibitory control, which is the ability to self-monitor and control one's behavior (Diamond, 2013), likely allows a parent to regulate emotions and supress impulsive, reactive actions when faced with stressful situations or challenging child behavior. Notably, these relations are stable across development. Maternal EF may thus play an important role in flexibly adapting behavior and strategies to the changing developmental needs of the child, ultimately supporting a mother's ability to be perceptive, responsive, and flexible, and effectively scaffold child behavior across a range of ages. In the presence of flexible and engaging maternal interactions, children, in turn, are more likely to engage in behavior that is emotionally responsive, and that balances autonomous play with positive involvement (Biringen et al., 2014).

Given the lasting, consistent role that maternal EF plays in parent-child interactions, the adaption and development of parenting interventions that aim to strengthen EF may serve as promising strategies to promote sensitive and responsive caregiving behavior. Outside of the parenting literature, interventions and training programs (e.g., mindfulness training) are effective in improving adult cognitive flexibility (Moore & Malinowski, 2009) and self-control (Friese et al., 2017). Promoting self-regulation has also been recognized as an important intervention target in parenting programs (Sanders et al., 2019). Bugental & Schwartz (2009) found that mothers who received a home visiting intervention with an enhanced cognitive component were less likely to use corporal punishment compared to mothers that received regular home visiting or no intervention. In sum, our findings highlight the important role of maternal EF in maternal and child behavior, suggesting that screening for difficulties in parental EF before service delivery, or including the enhancement of EF as an intervention goal, should be considered in the development of parenting interventions.

Despite the important role of EF, we did not find that EF mediated the association between maternal ACEs and EA. Of note, most studies that have examined the longitudinal links between ACEs and EF in adults have focused on high-risk or clinical populations (Guss et al., 2018; Hart & Rubia, 2012; Nikulina & Widom, 2013). In the presence of multiple psychiatric comorbidities, such as PTSD, depression, or anxiety, it is difficult to determine the effects on adult EF that are specific to ACEs (Hart & Rubia, 2012). Furthermore, given that the current sample experienced a relatively low exposure to adversity (67.6% of mothers reported zero or one ACEs), it is possible that deficits in EF may be related to a higher severity of ACEs (Twamley et al., 2004). Notably, in one previous study linking maternal ACEs, maternal EF (working memory and cognitive sensitivity), and maternal sensitivity in a low-risk community sample (Gonzalez et al., 2012), working memory emerged as a significant mediator, but only in a pathway that also included hypothalamic-pituitary-adrenal (HPA) axis function; maternal working memory was not directly associated with early life adversity. Future research is needed to better understand the role of maternal EF in the intergenerational transmission of ACEs, in various populations, and including the examination of other neurophysiological and neuropsychological mechanisms, such as HPA axis function, that may be implicated as well.

Limitations

This study has several strengths, including a longitudinal design, and the use of direct observations of mother-child interactions and standardized assessments of maternal EF. Furthermore, to our knowledge, this study was the first to examine the impact of maternal ACEs and maternal EF on both maternal and child EA across multiple timepoints. Nonetheless, there are limitations that should be considered. Firstly, maternal ACEs were measured retrospectively, which may be subject to underreporting due to recall bias or perceived stigma. However, current evidence supports the utility of such retrospective, self-report instruments, particularly when a range of experiences are covered (Hardt & Rutter, 2004). Secondly, assessments of only two components of maternal EF, cognitive flexibility and inhibitory control, were included. We therefore cannot conclude whether maternal working memory is associated with the examined variables. Given the role that working memory has been shown to play in parenting processes in previous research (Gonzalez et al., 2012; Sturge-Apple et al., 2014; Suor et al., 2017), further investigation considering all aspects of EF in relation to ACEs and EA, and importantly, whether these relations are persistent across development, is warranted. In addition, EF was only measured at a single time point. Although cognitive abilities in adults, including EF, are relatively stable overtime (Tucker-Drob & Briley, 2014), research has also demonstrated that EF can vary throughout adulthood (MacPherson et al., 2002), and may change in response to environmental influences, such as exposure to stress (Arnsten, 2009). It will be important for future work to examine maternal EF assessed at multiple time points. Finally, as noted previously, our sample was a relatively low-risk community sample. As such, results may not be generalizable to populations with higher demographic risk profiles, such as single parents and low-income families, or clinical populations (e.g., populations affected by parental psychopathology). Nonetheless, associations between maternal ACEs and EA were still detected in a low-risk sample, demonstrating that the longitudinal and intergenerational effects of ACEs are evident in populations with socioeconomic advantages.

Conclusions

Mothers, and children of mothers, with exposure to ACEs are at increased risk for lower emotional availability during parent-child interactions, however, these effects are not persistent as children age in a low-risk community sample. These results provide important new evidence regarding the intergenerational transmission of ACEs. Interventions aimed at improving parent-child relationships may be most effective when implemented early (i.e., at or before 18-months postpartum) for mothers with a history of ACEs. Moreover, we offer insights into the relations between maternal EF and EA, demonstrating that maternal EF plays an important and persistent role in maternal and child behavior across development. Parenting prevention and intervention efforts may benefit from incorporating strategies that support or enhance parental EF. Additional longitudinal research is needed in high-risk and clinical samples to better understand the roles that maternal ACEs and EF play in parent-child relationships across child development.

References

Adólfsdóttir, S., Haász, J., Wehling, E., Ystad, M., Lundervold, A., & Lundervold, A. (2014). Salient measures of inhibition and switching are associated with frontal lobe gray matter volume in healthy middle-aged and older adults. *Neuropsychology*, *28*(6), 859-869. https://doi.org/10.1037/neu0000082

Ainsworth, M. D. S., Blehar, M. C., Waters, E., & Wall, S. (1978). Patterns of attachment: A psychological study of the strange situation. Hillsdale, NJ: Erlbaum.

Ammerman, R., Peugh, J., Teeters, A., Putnam, F., & Van Ginkel, J. (2014). Child maltreatment history and response to CBT treatment in depressed mothers participating in home visiting. *Journal Of Interpersonal Violence, 31*(5), 774-791. https://doi.org/10.1177/0886260514556769

Anderson, D. I., Campos, J. J., Witherington, D. C., Dahl, A., Rivera, M., He, M., Uchiyama, I., & Barbu-Roth, M. (2013). The role of locomotion in psychological development. *Frontiers in Psychology, 4,* Article 440. https://doi.org/10.3389/fpsyg.2013.00440

Arnsten, A. (2009). Stress signalling pathways that impair prefrontal cortex structure and function. *Nature Reviews Neuroscience*, *10*(6), 410-422. https://doi.org/10.1038/nrn2648

Azar, S. T., McGuier, D. J., Miller, E. A., Hernandez-Mekonnen, R., & Johnson, D. R. (2017). Child neglect and maternal cross-relational social cognitive and neurocognitive disturbances. *Journal of Family Psychology, 31*, 8 –18. http://doi.org/10.1037/fam0000268

Bailey, H. N., DeOliveira, C. A., Wolfe, V. V., Evans, E. M., & Hartwick, C. (2012). The impact of childhood maltreatment history on parenting: A comparison of maltreatment types and assessment methods. *Child Abuse & Neglect, 36*(3), 236–246. https://doi.org/10.1016/j.chiabu.2011.11.005

Bandura, A. (1973). Aggression: A social learning analysis. Oxford: Prentice-Hall.

Banyard, V., Williams, L., & Siegel, J. (2003). The impact of complex trauma and depression on parenting: An exploration of mediating risk and protective factors. *Child Maltreatment, 8*(4), 334-349. https://doi.org/10.1177/1077559503257106

Barrett, B. (2010). Childhood sexual abuse and adulthood parenting: The mediating role of intimate partner violence. *Journal Of Aggression, Maltreatment & Trauma, 19*(3), 323-346. https://doi.org/10.1080/10926771003705205

Bartlett, J., & Easterbrooks, M. (2015). The moderating effect of relationships on intergenerational risk for infant neglect by young mothers. *Child Abuse & Neglect*, *45*, 21-34. https://doi.org/10.1016/j.chiabu.2015.02.018

Bates, D., Kliegl, R., Vasishth, S., & Baayen, R. H. (2015). Parsimonious mixed models. Available from arXiv:1506.04967 (stat.ME).

Berg, J.-L., Swan, N. M., Banks, S. J., & Miller, J. B. (2016). Atypical performance patterns on the Delis-Kaplan executive functioning system color-word interference tests: Cognitive switching and learning ability in older adults. *Journal* *of Clinical and Experimental Neuropsychology, 38*(7), 745–751. https://doi.org/10.1080/13803395.2016.1161734

Bernstein, D., & Fink, L. (1998). Manual for the Childhood Trauma Questionnaire. The Psychological Corporation, New York.

Bert, S. C., Guner, B. M., & Lanzi, R. G. (2009). The influence of maternal history of abuse on parenting knowledge and behavior. *Family Relations, 58*(2), 176–187. https://doi.org/10.1111/j.1741-3729.2008.00545.x

Biringen, Z., Derscheid, D., Vliegen, N., Closson, L., & Easterbrooks, M. (2014). Emotional availability (EA): Theoretical background, empirical research using the EA Scales, and clinical applications. *Developmental Review, 34*(2), 114–167. https://doi.org/10.1017/S0954579411000617

Biringen, Z., & Easterbrooks, M. (2012). Emotional availability: Concept, research, and window on developmental psychopathology. *Development and Psychopathology, 24*(1), 1–8. https://doi.org/10.1017/S0954579411000617

Bornstein, M. H., Suwalsky, J. D., Putnick, D. L., Gini, M., Venuti, P., de Falco, S., Heslington M., & Zingman de Galperin C. (2010). Developmental continuity and stability of emotional availability in the family: Two ages and two genders in child-mother dyads from two regions in three countries. *International Journal of Behavioral Development, 34*(5), 385–397. http://doi.org/10.1177/0165025409339080

Bos, K. Fox, N., Zeanah, C. H., Nelson, C. A. (2009). Effects of early psychosocial deprivation on the development of memory and executive function. *Frontiers In Behavioral Neuroscience*, *3*. https://doi.org/10.3389/neuro.08.016.2009

Bosquet Enlow, M., Egeland, B., Carlson, E., Blood, E., & Wright, R. (2014). Mother–infant attachment and the intergenerational transmission of posttraumatic stress disorder. *Development And Psychopathology*, *26*(1), 41-65. https://doi.org/10.1017/s0954579413000515

Bosquet Enlow, M., Englund, M. M., & Egeland, B. (2016). Maternal childhood maltreatment history and child mental health: Mechanisms in intergenerational effects. *Journal of Clinical Child and Adolescent Psychology, 47*(Suppl 1), S47–S62. https://doi.org/10.1080/15374416.2016.1144189

Bradley, R., Iida, M., Pennar, A., Owen, M., & Vandell, D. (2017). The dialectics of parenting: Changes in the interplay of maternal behaviors during early and middle childhood. *Journal of Child And Family Studies*, *26*(11), 3214-3225. https://doi.org/10.1007/s10826-017-0805-6

Bridgett, D., Kanya, M., Rutherford, H., & Mayes, L. (2017). Maternal executive functioning as a mechanism in the intergenerational transmission of parenting: Preliminary evidence. *Journal Of Family Psychology, 31*(1), 19-29. https://doi.org/10.1037/fam0000264

Bugental, D. B., & Schwartz, A. (2009). A cognitive approach to child mistreatment prevention among medically at-risk infants. *Developmental Psychology*, *45*(1), 284–288. https://doi.org/10.1037/a0014031

Campbell, S. B. (2002). *Behavior problems in preschool children: Clinical and developmental issues* (2nd ed.). Guilford Press.

Chamberlain, C., Gee, G., Harfield, S., Campbell, S., Brennan, S., Clark, Y., Mensah, F., Arabena, K., Herrman, H., & Brown, S. (2019). Parenting after a history of childhood maltreatment: A scoping review and map of evidence in the perinatal period. *PLoS One*, *14*(3), e0213460. https://doi.org/10.1371/journal.pone.0213460

Chico, E., Gonzalez, A., Ali, N., Steiner, M., & Fleming, A. (2014). Executive function and mothering: Challenges faced by teenage mothers. *Developmental Psychobiology*, *56*(5), 1027-1035. https://doi.org/10.1002/dev.21185

Chung, E. K., Mathew, L., Rothkopf, A. C., Elo, I. T., Coyne, J. C., & Culhane, J. F. (2009). Parenting attitudes and infant spanking: The influence of childhood experiences. *Pediatrics, 124*(2), e278–e286. https://doi.org/10.1542/peds.2008-3247

Cox, M., Mills-Koonce, R., Propper, C., & Gariépy, J. (2010). Systems theory and cascades in developmental psychopathology. *Development and Psychopathology*, *22*(3), 497-506. https://doi.org/10.1017/s0954579410000234

Crandall, A., Deater-Deckard, K., & Riley, A. W. (2015). Maternal emotion and cognitive control capacities and parenting: A conceptual framework. *Developmental Review, 36*, 105–126. http://doi.org/10.1016/j.dr.2015.01.004

Cuevas, K., Deater-Deckard, K., Kim-Spoon, J., Watson, A., Morasch, K., & Bell, M. (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. https://doi.org/10.1111/desc.12073

Curran, P., Obeidat, K., & Losardo, D. (2010). Twelve frequently asked questions about growth curve modeling. *Journal of Cognition and Development*, *11*(2), 121-136. https://doi.org/10.1080/15248371003699969

Dayton, C. J., Huth-Bocks, A. C., & Busuito, A. (2016). The influence of interpersonal aggression on maternal perceptions of infant emotions: Associations with early parenting quality. *Emotion, 16(4),* 436–448. https://doi.org/10.1037/emo0000114

Deater-Deckard, K., & Bell, M. A. (2017). Maternal executive function, heart rate, and EEG alpha reactivity interact in the prediction of harsh parenting. *Journal of Family Psychology, 31*(1), 41–50. http://doi.org/10.1037/fam0000286

Deater-Deckard, K., Chen, N., Wang, Z., & Bell, M. (2012). Socioeconomic risk moderates the link between household chaos and maternal executive function. *Journal of Family Psychology*, *26*(3), 391-399. https://doi.org/10.1037/a0028331

Deater-Deckard, K., Sewell, M., Petrill, S., & Thompson, L. (2010). Maternal working memory and reactive negativity in parenting. *Psychological Science*, *21*(1), 75-79. https://doi.org/10.1177/0956797609354073

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. https://doi.org/10.1177/ 1077559513497420

Delis, D. C., Kaplan, E., & Kramer, J. H. (2001a). *Delis-Kaplan Executive Function System: Examiner's manual.* San Antonio, TX: Psychological Corporation.

Delis, D. C., Kaplan, E., & Kramer, J. H. (2001b). *Delis-Kaplan Executive Function System: Technical manual*. San Antonio, TX: Psychological Corporation.

Demakis, G. (2003). A meta-analytic review of the sensitivity of the Wisconsin Card Sorting Test to frontal and lateralized frontal brain damage. *Neuropsychology*, *17*(2), 255-264. https://doi.org/10.1037/0894-4105.17.2.255

Diamond, A. (2013). Executive functions. *Annual Review of Psychology, 64*(1), 135–168. https://doi.org/10.1146/annurev-psych-113011-143750

DiLillo, D., Tremblay, G. C., & Peterson, L. (2000). Linking childhood sexual abuse and abusive parenting: The mediating role of maternal anger. *Child Abuse & Neglect, 24*(6), 767–779. https://doi.org/10.1016/S0145-2134(00)00138-1

Dixon, L., Browne, K., & Hamilton-Giachritsis, C. (2008). Patterns of risk and protective factors in the intergenerational cycle of maltreatment. *Journal of Family Violence*, *24*(2), 111-122. https://doi.org/10.1007/s10896-008-9215-2

Dixon, L., Hamilton-Giachritsis, C., & Browne, K. (2005). Attributions and behaviours of parents abused as children: A mediational analysis of the intergenerational continuity of child maltreatment (Part II). *Journal of Child Psychology and Psychiatry, 46*(1), 58-68. https://doi.org/10.1111/j.1469-7610.2004.00340.x

Drewe, E. A. (1974). The effect of type and area of brain lesion on Wisconsin Card Sorting Test performance. *Cortex*, *10*(2), 159–170. http://doi.org/10.1016/S0010-9452(74)80006-7

Driscoll, J. R., & Easterbrooks, M. (2007). Young mothers' splay with their toddlers: Individual variability as a function of psychosocial factors. *Infant and Child Development, 16*(6), 649–670. https://doi.org/10.1002/icd.515

Dube, S., Felitti, V., Dong, M., Chapman, D., Giles, W., & Anda, R. (2003). Childhood abuse, neglect, and household dysfunction and the risk of illicit drug use: The adverse childhood experiences study. *Pediatrics*, *111*(3), 564-572. https://doi.org/10.1542/peds.111.3.564

Dubowitz, H., Black, M., Kerr, M., Hussey, J., Morrel, T., Everson, M., & Starr, R. (2001). Type and timing of mothers' victimization: Effects on mothers and children. *Pediatrics*, *107*(4), 728-735. https://doi.org/10.1542/peds.107.4.728

Else-Quest, N. M., Clark, R., & Owen, M. T. (2011). Stability in mother-child interactions from infancy through adolescence. *Parenting: Science and Practice, 11*(4), 280–287. https://doi.org/10.1080/15295192.2011.613724

Enders, CK. (2010). *Applied missing data analysis.* Guilford Press.

Feldman, R. (2010). The relational basis of adolescent adjustment: Trajectories of mother-child interactive behaviors from infancy to adolescence shape adolescents' adjustment. *Attachment and Human Development, 12*(1-2), 173–192. https://doi.org/10.1080/14616730903282472

Felitti, V., Anda, R., Nordenberg, D., Williamson, D., Spitz, A., Edwards, V., Koss M. P., & Marks J. S. (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. https://doi.org/10.1016/s0749-3797(98)00017-8

Finegood, E., Blair, C., Granger, D., Hibel, L., & Mills-Koonce, R. (2016). Psychobiological influences on maternal sensitivity in the context of adversity. *Developmental Psychology*, *52*(7), 1073-1087. https://doi.org/10.1037/dev0000123

Friese, M., Frankenbach, J., Job, V., & Loschelder, D. (2017). Does self-control training improve self-control? A meta-analysis. *Perspectives on Psychological Science*, *12*(6), 1077-1099. https://doi.org/10.1177/1745691617697076

Fuchs, A., Möhler, E., Resch, F., & Kaess, M. (2015). Impact of a maternal history of childhood abuse on the development of mother–infant interaction during the first year of life. *Child Abuse & Neglect*, *48*, 179-189. https://doi.org/10.1016/j.chiabu.2015.05.023

George, C., & Solomon, J. (2008). The caregiving system: A behavioral systems approach to parenting. In J. Cassidy & P. R. Shaver (Eds.), *Handbook of attachment: Theory, research, and clinical applications* (p. 833–856). The Guilford Press.

Gläscher, J., Adolphs, R., & Tranel, D. (2019). Model-based lesion mapping of cognitive control using the Wisconsin Card Sorting Test. *Nature Communications*, *10*(1), 20. https://doi.org/10.1038/s41467-018-07912-5

Gonzalez, A., Atkinson, L., & Fleming, A. S. (2009). Attachment and the comparative psychobiology of mothering. In M. de Haan & M. R. Gunnar (Eds.), *Handbook of developmental social neuroscience* (pp. 225–245). Guilford Press.

Gonzalez, A., Jenkins, J., Steiner, M., & Fleming, A. (2012). Maternal early life experiences and parenting: The mediating role of cortisol and executive function. *Journal of the American Academy of Child & Adolescent Psychiatry*, *51*(7), 673-682. https://doi.org/10.1016/j.jaac.2012.04.003

Grant, D., & Berg, E. (1948). A behavioral analysis of degree of reinforcement and ease of shifting to new responses in a Weigl-type card-sorting problem. *Journal of Experimental Psychology*, *38*(4), 404-411. https://doi.org/10.1037/h0059831

Guss, S., Morris, A., Bosler, C., Castle, S., Hays-Grudo, J., Horm, D., & Treat, A. (2018). Parents' adverse childhood experiences and current relationships with their young children: The role of executive function. *Early Child Development and Care,* 1-11. https://doi.org/10.1080/03004430.2018.1513921

Hardt, J., & Rutter, M. (2004). Validity of adult retrospective reports of adverse childhood experiences: Review of the evidence. *Journal of Child Psychology and Psychiatry, 45*(2), 260-273. https://doi.org/10.1111/j.1469-7610.2004.00218.x

Hart, H., & Rubia, K. (2012). Neuroimaging of child abuse: A critical review. *Frontiers in Human Neuroscience*, *6*(52). https://doi.org/10.3389/fnhum.2012.00052

Hillis, S., Anda, R., Dube, S., Felitti, V., Marchbanks, P., & Marks, J. (2004). The association between adverse childhood experiences and adolescent pregnancy, long-term psychosocial consequences, and fetal death. *Pediatrics*, *113*(2), 320-327. https://doi.org/10.1542/peds.113.2.320

Hughes, K., Bellis, M., Hardcastle, K., Sethi, D., Butchart, A., Mikton, C., Jones, J., & Dunne, M. P. (2017). The effect of multiple adverse childhood experiences on health: A systematic review and meta-analysis. *The Lancet Public Health*, *2*(8), e356-e366. https://doi.org/10.1016/s2468-2667(17)30118-4

Iyengar, U., Kim, S., Martinez, S., Fonagy, P., & Strathearn, L. (2014). Unresolved trauma in mothers: Intergenerational effects and the role of reorganization. *Frontiers in Psychology*, *5,* Article 966. https://doi.org/10.3389/fpsyg.2014.00966

Juul, S., Hendrix, C., Robinson, B., Stowe, Z., Newport, D., Brennan, P., & Johnson, K. (2015). Maternal early-life trauma and affective parenting style: The mediating role of HPA-axis function. *Archives of Women's Mental Health*, *19*(1), 17-23. https://doi.org/10.1007/s00737-015-0528-x

Kalmakis, K., & Chandler, G. (2015). Health consequences of adverse childhood experiences: A systematic review. *Journal of the American Association of Nurse Practitioners*, *27*(8), 457-465. https://doi.org/10.1002/2327-6924.12215

Kessler, R., Berglund, P., Chiu, W., Demler, O., Heeringa, S., Hiripi, E., Jin, R., Pennell, B. E., Walters, E. E., Zaslavsky, A., & Zheng, H. (2004). The US National Comorbidity Survey Replication (NCS-R): Design and field procedures. *International Journal of Methods in Psychiatric Research*, *13*(2), 69-92. https://doi.org/10.1002/mpr.167

Kluczniok, D., Boedeker, K., Fuchs, A., Hindi Attar, C., Fydrich, T., Fuehrer, D. Dittrich, K., Reck, C., Winter, S., Heinz, A., Herpertz S. C., Brunner, R., & Bermpohl, F. (2015). Emotional availability in mother-child interaction: The effects of maternal depression in remission and additional history of childhood abuse. *Depression and Anxiety*, *33*(7), 648-657. https://doi.org/10.1002/da.22462

Kunseler, F., Oosterman, M., de Moor, M., Verhage, M., & Schuengel, C. (2016). Weakened resilience in parenting self-efficacy in pregnant women who were abused in childhood: An experimental test. *PloS one. 11*(2), e0141801. https://doi.org/10.1371/journal.pone.0141801

Labella, M. H., Raby, K. L., Martin, J., & Roisman, G. I. (2019). Romantic functioning mediates prospective associations between childhood abuse and neglect and parenting outcomes in adulthood. *Development and Psychopathology, 31*(1), 95-111. https://doi.org/10.1017/S095457941800158X

Lang, A. J., Gartstein, M. A., Rodgers, C. S., & Lebeck, M. M. (2010). The impact of maternal childhood abuse on parenting and infant temperament. *Journal of Child and Adolescent Psychiatric Nursing, 23*(2), 100–110. http://doi.org/10.1111/j.1744-6171.2010.00229.x

Lange, B., Callinan, L., & Smith, M. (2019). Adverse childhood experiences and their relation to parenting stress and parenting practices. *Community Mental Health Journal*, *55*(4), 651-662. https://doi.org/10.1007/s10597-018-0331-z

Lehnig, F., Nagl, M., Stepan, H., Wagner, B., & Kersting, A. (2019). Associations of postpartum mother-infant bonding with maternal childhood maltreatment and postpartum mental health: A cross-sectional study. *BMC Pregnancy and Childbirth*, *19*(1). https://doi.org/10.1186/s12884-019-2426-0

Leslie, L., & Cook, E. (2015). Maternal trauma and adolescent depression: Is parenting style a moderator?. *Psychology, 6*(6), 681-688. https://doi.org/10.4236/psych.2015.66066

Lipman, E., MacMillan, H., & Boyle, M. (2001). Childhood abuse and psychiatric disorders among single and married mothers. *American Journal of Psychiatry*, *158*(1), 73-77. https://doi.org/10.1176/appi.ajp.158.1.73

Lomanowska, A., Boivin, M., Hertzman, C., & Fleming, A. (2017). Parenting begets parenting: A neurobiological perspective on early adversity and the transmission of parenting styles across generations. *Neuroscience*, *342*, 120-139. https://doi.org/10.1016/j.neuroscience.2015.09.029

Lyons–Ruth, K., Block, D., 1996. The disturbed caregiving system: Relations among childhood trauma, maternal caregiving, and infant affect and attachment. *Infant Mental Health Journal, 17*(3), 257–275. https://doi.org/10.1002/(SICI)1097-0355(199623)17:3<257::AID-IMHJ5>3.0.CO;2-L

Maas, C. J., & Hox, J. J. (2005). Sufficient sample sizes for multilevel modeling. *Methodology, 1*(3), 86–92. http://doi.org/10.1027/1614-1881.1.3.86.

MacPherson, S. E., Phillips, L. H., & Della Sala, S. (2002). Age, executive function and social decision making: A dorsolateral prefrontal theory of cognitive aging. *Psychology and Aging, 17*(4), 598-609. http://doi.org/10.1037//0882-7974.17.4.598

Madigan, S., Cyr, C., Eirich, R., Fearon, R., Ly, A., Rash, C., Poole, J., & Alink, L. R. A. (2019). Testing the cycle of maltreatment hypothesis: Meta-analytic evidence of the intergenerational transmission of child maltreatment. *Development and Psychopathology*, *31*(1), 23-51. https://doi.org/10.1017/s0954579418001700

Madigan, S., Wade, M., Plamondon, A., & Jenkins, J. (2015). Maternal abuse history, postpartum depression, and parenting: Links with preschoolers' internalizing problems. *Infant Mental Health Journal, 36*(2), 146-155. https://doi.org/10.1002/imhj.21496

Madigan, S., Wade, M., Tarabulsy, G., Jenkins, J. M., & Shouldice, M. (2014). Association between abuse history and adolescent pregnancy: A meta-analysis. *Journal of Adolescent Health, 55*(2), 151–159. https://doi.org/10.1016/j.jadohealth.2014.05.002

Martinez-Torteya, C., Dayton, C., Beeghly, M., Seng, J., McGinnis, E., & Broderick, A., Rosenblum, K., & Muzik, M. (2014). Maternal parenting predicts infant biobehavioral regulation among women with a history of childhood maltreatment. *Development and Psychopathology, 26*(2), 379-392. https://doi.org/10.1017/s0954579414000017

Matte-Gagné, C., Stack, D., & Serbin, L. (2018). Developmental patterns of change in mother and child emotional availability from infancy to the end of the preschool years: A four-wave longitudinal study. *Infant Behavior and Development*, *52*, 76-88. https://doi.org/10.1016/j.infbeh.2018.05.005

Matuschek, H., Kliegl, R., Vasishth, S., Baayen, H., & Bates, D. (2017). Balancing Type I error and power in linear mixed models. *Journal of Memory and Language*, *94*, 305-315. https://doi.org/10.1016/j.jml.2017.01.001

McCarthy, G., & Maughan, B. (2010). Negative childhood experiences and adult love relationships: The role of internal working models of attachment. *Attachment & Human Development*, *12*(5), 445-461. https://doi.org/10.1080/14616734.2010.501968

McDonald, S., & Tough, S. (2014). *The Alberta Adverse Childhood Experiences Survey 2013*. Calgary: Alberta Centre for Child, Family, and Community Research.

Mielke, E., Neukel, C., Bertsch, K., Reck, C., Möhler, E., & Herpertz, S. (2016). Maternal sensitivity and the empathic brain: Influences of early life maltreatment. *Journal of Psychiatric Research*, *77*, 59-66. https://doi.org/10.1016/j.jpsychires.2016.02.013

Milan, S., Lewis, J., Ethier, K., Kershaw, T., & Ickovics, J. R. (2004). The impact of physical maltreatment history on the adolescent mother-infant relationship: Mediating and moderating effects during the transition to early parenthood. *Journal of Abnormal Child Psychology, 32*(3), 249–261. https://doi.org/10.1023/b:jacp.0000026139.01671.fd

Mitchell, E., Nuttall, A., & Wittenborn, A. (2019). Maternal depressive symptoms and warm responsiveness across the transition to parenthood. *Journal of Child and Family Studies*, *28*(6), 1604-1612. https://doi.org/10.1007/s10826-019-01392-x

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. https://doi.org/10.1006/cogp.1999.0734

Moe, V., von Soest, T., Fredriksen, E., Olafsen, K., & Smith, L. (2018). The multiple determinants of maternal parenting stress 12 months after birth: The contribution of antenatal attachment style, adverse childhood experiences, and infant temperament. *Frontiers in Psychology*, *9,* 1987. https://doi.org/10.3389/fpsyg.2018.01987

Moehler, E., Biringen, Z., & Poustka, L. (2007). Emotional availability in a sample of mothers with a history of abuse. *American Journal of Orthopsychiatry*, *77*(4), 624-628. https://doi.org/10.1037/0002-9432.77.4.624

Möhler, E., Resch, F., Cierpka, A., & Cierpka, M. (2001). The early appearance and intergenerational transmission of maternal traumatic experiences in the context of mother–infant interaction. *Journal of Child Psychotherapy, 27*(3), 257–271. https://doi.org/10.1080/00754170110087540

Moore, A., & Malinowski, P. (2009). Meditation, mindfulness and cognitive flexibility. *Consciousness and Cognition*, *18*(1), 176-186. https://doi.org/10.1016/j.concog.2008.12.008

Morelen, D., Menke, R., Rosenblum, K., Beeghly, M., & Muzik, M. (2016). Understanding bidirectional mother-infant affective displays across contexts: Effects of maternal maltreatment history and postpartum depression and PTSD symptoms. *Psychopathology, 49*(4), 305-314. https://doi.org/10.1159/000448376

Murphy, A., Steele, M., Dube, S., Bate, J., Bonuck, K., Meissner, P., Goldman, H., & Steele, H. (2014). Adverse Childhood Experiences (ACEs) Questionnaire and Adult Attachment Interview (AAI): Implications for parent child relationships. *Child Abuse & Neglect*, *38*(2), 224-233. https://doi.org/10.1016/j.chiabu.2013.09.004

Musser, E., Kaiser-Laurent, H., & Ablow, J. (2012). The neural correlates of maternal sensitivity: An fMRI study. *Developmental Cognitive Neuroscience*, *2*(4), 428-436. https://doi.org/10.1016/j.dcn.2012.04.003

Muthén, L., & Muthén, B. (2017). Mplus User's Guide. Eighth Edition. Los Angeles, CA: Muthén & Muthén.

Muzik, M., Bocknek, E., Broderick, A., Richardson, P., Rosenblum, K., Thelen, K., & Seng, J. (2013). Mother–infant bonding impairment across the first 6 months postpartum: The primacy of psychopathology in women with childhood abuse and neglect histories. *Archives of Women's Mental Health*, *16*(1), 29-38. https://doi.org/10.1007/s00737-012-0312-0

Navalta, C. P., Polcari, A., Webster, D. M., Boghossian, A., & Teicher, M. (2006). Effects of childhood sexual abuse on neuropsychological and cognitive function in college women. *The Journal of Neuropsychiatry and Clinical Neurosciences, 18*(1), 45–53. https://doi.org/10.1176/appi.neuropsych.18.1.45

Newton, E. K., Laible, D., Carlo, G., Steele, J. S., & McGinley, M. (2014). Do sensitive parents foster kind children, or vice versa? Bidirectional influences between children's prosocial behavior and parental sensitivity. *Developmental Psychology, 50*(6), 1808–1816. http://doi.org/10.1037/a0036495

Nikulina, V., & Widom, C. S. (2013). Child maltreatment and executive functioning in middle adulthood: A prospective examination. *Neuropsychology, 27*(4), 417– 427. http://doi.org/10.1037/a0032811

Paivio, S. C., & Cramer, K. M. (2004). Factor structure and reliability of the Childhood Trauma Questionnaire in a Canadian undergraduate student sample. *Child Abuse & Neglect, 28*(8), 889-904. https://doi.org/10.1016/j.chiabu.2004.01.011

Pasalich, D., Cyr, M., Zheng, Y., McMahon, R., & Spieker, S. (2016). Child abuse history in teen mothers and parent–child risk processes for offspring externalizing problems. *Child Abuse & Neglect*, *56*, 89-98. https://doi.org/10.1016/j.chiabu.2016.04.011

Pears, K. C., & Capaldi, D. M. (2001). Intergenerational transmission of abuse: A two-generational prospective study of an at-risk sample. *Child Abuse & Neglect, 25*(11), 1439–1461. https://doi.org/10.1016/S0145-2134(01)00286-1

Pereira, J., Vickers, K., Atkinson, L., Gonzalez, A., Wekerle, C., & Levitan, R. (2012). Parenting stress mediates between maternal maltreatment history and maternal sensitivity in a community sample. *Child Abuse & Neglect*, *36*(5), 433-437. https://doi.org/10.1016/j.chiabu.2012.01.006

Pianta, R. C., Sroufe, L. A., & Egeland, B. (1989). Continuity and discontinuity in maternal sensitivity at 6, 24, and 42 months in a high-risk sample. *Child Development, 60*(2), 481–487. https://doi.org/10.2307/1130992

Racine, N., Madigan, S., Plamondon, A., McDonald, S., & Tough, S. (2018). Differential associations of adverse childhood experience on maternal health. *American Journal of Preventive Medicine*, *54*(3), 368-375. https://doi.org/10.1016/j.amepre.2017.10.028

Radloff, L. S. (1977). The CES-D Scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement, 1*(3), 385–401. https://doi.org/10.1177/014662167700100306

Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods.* Thousand Oaks, CA: Sage.

Rhodes, M. G. (2004). Age-related differences in performance on the Wisconsin Card Sorting Test: A meta-analytic review. *Psychology and Aging*, *19*(3), 482–494. http://doi.org/10.1037/0882-7974.19.3.482

Rijlaarsdam, J., Stevens, G. W. J. M., Jansen, P. W., Ringoot, A. P., Jaddoe, V. W. V., Hofman, A., Ayer, L., Verhulst F. C., Hudziak, J. J., & Tiemeier, H. (2014). Maternal childhood maltreatment and offspring emotional and behavioral problems: Maternal and paternal mechanisms of risk transmission. *Child Maltreatment, 19*(2), 67–78. http://doi.org/10.1177/1077559514527639

Roberts, R., O'Connor, T., Dunn, J., & Golding, J. (2004). The effects of child sexual abuse in later family life; mental health, parenting and adjustment of offspring. *Child Abuse & Neglect, 28*(5), 525-545. https://doi.org/10.1016/j.chiabu.2003.07.006

Rodriguez, C. M., & Tucker, M. C. (2011). Behind the cycle of violence, beyond abuse history: A brief report on the association of parental attachment to physical child abuse potential. *Violence and Victims, 26*(2), 246–256. https://doi.org/10.1891/0886-6708.26.2.246

Sanders, M., Turner, K., & Metzler, C. (2019). Applying self-regulation principles in the delivery of parenting interventions. *Clinical Child and Family Psychology Review*, *22*(1), 24-42. https://doi.org/10.1007/s10567-019-00287-z

Savage, L., Tarabulsy, G., Pearson, J., Collin-Vézina, D., & Gagné, L. (2019). Maternal history of childhood maltreatment and later parenting behavior: A meta-analysis. *Development and Psychopathology*, *31*(1), 9-21. https://doi.org/10.1017/s0954579418001542

Scher, C. D., Stein, M. B., Asmundson, G. J., McCreary, D. R., & Forde, D. R. (2001). The childhood trauma questionnaire in a community sample: Psychometric properties and normative data. *Journal of Traumatic Stress, 14*(4), 843–857. https://doi.org/10.1023/A:1013058625719

Schofield, T. J., Lee, R. D., & Merrick, M. T. (2013). Safe, stable, nurturing relationships as a moderator of intergenerational continuity of child maltreatment: A meta-analysis. *Journal of Adolescent Health, 53*(4), S32–S38. https://doi.org/10.1016/j.jadohealth.2013.05.004

Schuetze, P., & Eiden, R. D. (2005). The relationship between sexual abuse during childhood and parenting outcomes: Modeling direct and indirect pathways. *Child Abuse & Neglect, 29*(6), 645–659. https://doi.org/10.1016/ j.chiabu.2004.11.004

Sexton, M. B., Davis, M. T., Menke, R., Raggio, G. A., & Muzik, M. (2017). Mother–child interactions at six months postpartum are not predicted by maternal histories of abuse and neglect or maltreatment type. *Psychological Trauma: Theory, Research, Practice, and Policy, 9*(5), 622–626. https://doi.org/10.1037/tra0000272

Shaffer, A., & Obradović, J. (2017). Unique contributions of emotion regulation and executive functions in predicting the quality of parent–child interaction behaviors. *Journal of Family Psychology*, *31*(2), 150-159. https://doi.org/10.1037/fam0000269

Shenk, C., Ammerman, R., Teeters, A., Bensman, H., Allen, E., Putnam, F., & Van Ginkel, J. (2017). History of maltreatment in childhood and subsequent parenting stress in at-risk, first-time mothers: Identifying points of intervention during home visiting. *Prevention Science, 18*(3), 361-370. https://doi.org/10.1007/s11121-017-0758-4

Singer, J. D., & Willett, J. B. (2003). *Applied longitudinal data analysis: Modeling change and event occurrence.* Oxford University Press.

Smith, A. L., Cross, D., Winkler, J., Jovanovic, T., & Bradley, B. (2014). Emotional dysregulation and negative affect mediate the relationship between maternal history of child maltreatment and maternal child abuse potential. *Journal of Family Violence, 29*(5), 483–494. http://dx.doi.org/10.1007/s10896-014-9606-5

Stack, D., Matte-Gagné, C., & Dickson, D. (2019). Persistence of effects of VLBW/PT birth status and maternal Emotional Availability (EA) on child EA trajectories. *Frontiers in Psychology*, *9* Article 2715. https://doi.org/10.3389/fpsyg.2018.02715

Steele, H., Bate, J., Steele, M., Dube, S., Danskin, K., & Knafo, H., Nikitiades, A., Bonuck, K., Meissner, P., & Murphy, A. (2016). Adverse childhood experiences, poverty, and parenting stress. *Canadian Journal Of Behavioural Science / Revue Canadienne Des Sciences Du Comportement*, *48*(1), 32-38. https://doi.org/10.1037/cbs0000034

Stevenson-Hinde, J., & Shouldice, A. (1995). Maternal interactions and self-reports related to attachment classifications at 4.5 years. *Child Development*, *66*(3), 583–596. https://doi.org/10.2307/1131936

Stroop, J. R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology, 18*(6), 643–662. https://doi.org/10.1037/h0054651

Sturge-Apple, M., Jones, H., & Suor, J. (2017). When stress gets into your head: Socioeconomic risk, executive functions, and maternal sensitivity across childrearing contexts. *Journal of Family Psychology*, *31*(2), 160-169. https://doi.org/10.1037/fam0000265

Sturge-Apple, M., Suor, J., & Skibo, M. (2014). Maternal child-centered attributions and harsh discipline: The moderating role of maternal working memory across socioeconomic contexts. *Journal of Family Psychology*, *28*(5), 645-654. https://doi.org/10.1037/fam0000023

Suor, J., Sturge-Apple, M., & Skibo, M. (2017). Breaking cycles of risk: The mitigating role of maternal working memory in associations among socioeconomic status, early caregiving, and children's working memory. *Development and Psychopathology*, *29*(4), 1133-1147. https://doi.org/10.1017/s095457941600119x

Treat, A., Sheffield Morris, A., Williamson, A., Hays-Grudo, J., & Laurin, D. (2017). Adverse childhood experiences, parenting, and child executive function. *Early Child Development and Care*, *189*(6), 1-12. https://doi.org/10.1080/03004430.2017.1353978

Tucker-Drob, E., & Briley, D. (2014). Continuity of genetic and environmental influences on cognition across the life span: A meta-analysis of longitudinal twin and adoption studies. *Psychological Bulletin*, *140*(4), 949-979. https://doi.org/10.1037/a0035893

Twamley, E., Hami, S., & Stein, M. (2004). Neuropsychological function in college students with and without posttraumatic stress disorder. *Psychiatry Research*, *126*(3), 265-274. https://doi.org/10.1016/j.psychres.2004.01.008

Vaillancourt, K., Pawlby, S., & Fearon, R. (2017). History of childhood abuse and mother-infant interactions: A systematic review of observational studies. *Infant Mental Health Journal*, *38*(2), 226-248. https://doi.org/10.1002/imhj.21634

Waldman-Levi, A., Finzi-Dottan, R., & Weintraub, N. (2015). Attachment security and parental perception of competency among abused women in the shadow of PTSD and childhood exposure to domestic violence. *Journal of Child and Family Studies*, *24*(1), 57-65. https://doi.org/10.1007/s10826-013-9813-3

Wang, F., Christ, S., Mills-Koonce, R., Garrett-Peters, P., & Cox, M. (2013). Association between maternal sensitivity and externalizing behavior from preschool to preadolescence. *Journal of Applied Developmental Psychology, 34*(2), 89–100. https://doi.org/10.1016/j.appdev.2012.11.003

Weinberg, M., Tronick, E., Beeghly, M., Olson, K., Kernan, H., & Riley, J. (2001). Subsyndromal depressive symptoms and major depression in postpartum women. *American Journal of Orthopsychiatry*, *71*(1), 87-97. https://doi.org/10.1037/0002-9432.71.1.87

Weissman, M. M., Sholomskas, D., Pottenger, M., Prusoff, B. A., & Locke, B. A. (1977). Assessing depressive symptoms in five psychiatric populations: A validation study. *American Journal of Epidemiology, 106*(3), 203–214. https://doi.org/10.1093/oxfordjournals.aje.a112455

Zelazo, P. (2015). Executive function: Reflection, iterative reprocessing, complexity, and the developing brain. *Developmental Review*, *38*, 55-68. https://doi.org/10.1016/j.dr.2015.07.001

Zvara, B. J., Mills-Koonce, W. R., & Cox, M. (2017). Maternal childhood sexual trauma, child directed aggression, parenting behavior, and the moderating role of child sex. *Journal of Family Violence, 32*(2), 219–229. https://doi.org/10.1007/s10896-016-9839-6