THE RELATIONS AMONG STRESS, EXECUTIVE FUNCTIONS, AND HARSH PARENTING IN MOTHERS

by

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Abstract

Stress is a common experience in most mothers' lives, and theoretical models posit that mothers' experience of stress may spillover into their parenting behaviours. However, individual factors, such as maternal executive functioning (EF) skills, may buffer the association between stress and parenting. Research has examined these associations using correlational designs with socioeconomic status (SES) and household chaos used as indicators of stress, and has demonstrated inconsistent patterns with regard to the moderating role of EF. The first aim of this study was to replicate previous findings by examining how maternal EF moderates the association between SES and household chaos, and harsh parenting. Furthermore, because correlational research designs preclude the ability to make causal inferences about the effects of stress on parenting, the second aim of this study extended existing research by investigating the effects of experimentally induced stress on harsh parenting behaviours and whether maternal EF moderates these effects. The second aim also investigated these questions in relation to child-blaming attributions. To accomplish these aims, a sample of 104 mothers with children (6-10 years old) participated in a laboratory-based study. Mothers completed measures that assessed their EF skills, household chaos, SES, and harsh parenting behaviours. Additionally, mothers were randomly assigned to either a stress group, where they performed a speech in front of a panel of judges, or a control group. Following the stress (or control) induction, mothers rated their child-blaming attributions and harsh parenting behaviours in response to vignettes of common child misbehaviours. Findings from the first aim revealed an interaction between household chaos and EF (assessed with cognitive tasks), such that greater EF skills reduced the association between household chaos and harsh parenting behaviours. However, findings from the second aim indicated no significant effects of experimentally induced stress on child-blaming

attributions or harsh parenting behaviours, and EF was not a significant moderator. These results highlight the buffering role of task-based EF skills for more chronic stressors such as household chaos. More acute stress, or stress that is more distal to parenting (e.g., SES) may be less relevant. The findings from this study provide pertinent directions for future research.

Lay Summary

Every mother experiences some form of stress in her life, however, little is known about how stress affects parenting. This dissertation explored whether stress is associated with how harshly mothers parent their children, and, whether mothers' executive functioning skills, otherwise known as self-regulation skills that are involved with planning, organization, and problem solving, reduced the associations between stress and harsh parenting behaviours. The results demonstrated that mothers' executive functioning skills reduced associations between household chaos (a form of more chronic stress within the home), and harsh parenting behaviours. However, acute stress that was induced by asking mothers to perform a stressful speech did not have any effects on parenting, and the relationship between acute stress and parenting did not depend on the level of mothers' executive functioning skills. This dissertation provides important suggestions and directions for future research examining the interrelationships between stress, executive functioning, and parenting.

Preface

I was responsible for the identification and design of this research project, and I trained and directed a team of undergraduate research assistants and directed studies students in data collection, cleaning, and coding. I performed all data analysis and writing of the dissertation. I did all the above with guidance and consultation from Dr. Charlotte Johnston, who is my supervisor and the principal investigator of the UBC Parenting Lab.

This study was approved by the Behavioural Research Ethics Board at the University of British Columbia (Approval Certificate Number: H17-02560).

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Dedication

I dedicate this dissertation to my husband, Gavin Hodges. From his patience and understanding when I was working late, his willingness to help in various aspects of this project, his encouragement and pep talks when I was discouraged, he has been my rock through it all. Words cannot express how grateful I am for his constant love and support.

1. Introduction

There are approximately three million families with dependent children living in Canada (Statistics Canada, 2017a), and therefore three to six million or more parents who are raising these children. These parents play an important role in socializing their children, most proximally through their parenting behaviours (Bornstein, 2001; Collins, Maccoby, Steinberg, Hetherington, & Bornstein, 2000). In particular, harsh parenting behaviours, typically characterized as behaviours that place demands on the child or attempts to control the child's behaviour with the use of anger, coercion, aggression, and/or a raised voice (Arnold, O'Leary, Wolff, & Acker, 1993; Rueger, Katz, Risser, & Lovejoy, 2011), have been implicated by many well-documented theories as important contributors to child maladjustment.

For example, social learning theory emphasizes the role of parental consequences in promoting and maintaining child behaviours (Patterson, 1982). Specifically, within the social learning model and focused on externalizing child problems, coercion theory depicts a cycle of negative reinforcement whereby both parent harsh behaviour and child negative behaviour escalate until either child or parent withdraws, reinforcing the other's negative behaviour (child conduct problems or harsh parenting; Patterson, 1982). Other theories describe how, in response to harsh parenting behaviours, children develop internalizing problems by reacting with sadness or anxiety, or learning to cope through withdrawal (e.g., Field, 1995; McKee, Colletti, Rakow, Jones, & Forehand, 2008; Tronick & Gianino, 1986). In support of these theories, studies have consistently demonstrated a link between harsh parenting behaviours and both internalizing and externalizing child behaviour problems in clinical and non-clinical samples of children, and in both cross-sectional and longitudinal designs (e.g., Hipwell et al., 2008; McLeod, Weisz, & Wood, 2007; Rothbaum & Weisz, 1994). Given the well-established links between harsh

parenting and child behaviour problems, research has shifted to identifying determinants of harsh parenting behaviour, which may help to inform intervention efforts. This is a particularly important area of research due to the long-term and high economic, social, and personal costs associated with both internalizing and externalizing behaviour problems in childhood (Buchanan-Pascall, 2018; Edwards, Céilleachair, Bywater, Hughes, & Hutchings, 2007).

One critical avenue of exploration is how the parental experience of stress is associated with harsh parenting. Parenting is often a stressful experience, and most parents, in addition to the important role of raising their child, have other responsibilities that may manifest as financial stress, job stress, relationship stress, and/or the stress of running and organizing a home. Indeed, extant studies have found associations between variables such as socioeconomic status (SES) and household chaos with harsh parenting (e.g., Mills-Koonce et al., 2016; Tucker & Rodriguez, 2014), suggesting that these external stressors (lower SES, greater household chaos) affect the way parents interact with their children. At the same time, individual factors, such as parental executive function (EF), or the top-down mental processes that enable goal directed behaviour (Diamond, 2013), have been identified as potentially important correlates of harsh parenting (e.g., Crandall, Deater-Deckard, & Riley, 2015). In particular, EF skills may not only help parents to problem solve and control impulses in typical situations, but they also may help parents flexibly and adaptively respond to the demanding and stressful situations mentioned previously. That is, stress may have less impact on the parenting behaviours of parents with stronger EF skills because they are more able to compensate for the negative effects of stress compared to parents with weaker EF skills. This idea that parental EF may interact with the experience of stress to predict harsh parenting behaviours is a growing area of investigation in the literature. However, findings have been somewhat inconsistent with regard to the presence

and direction of such an interaction (e.g., Deater-Deckard, Wang, Chen, & Bell, 2012b; Sturge-Apple, Suor, & Skibo, 2014). In the current study, my first aim was to replicate and extend previous findings by examining the interaction between two different indicators of contextual stress (i.e., SES and household chaos), and two different methods of assessing EF (task-based or self-reported) in predicting harsh parenting behaviours in a community sample of mothers. In the second aim, I extended this research by investigating whether an experimental manipulation of stress impacts harsh parenting behaviours. I also extended the research by measuring child-blaming attributions, a correlate of both harsh parenting behaviours and poor child outcomes. Finally, I examined whether maternal EF (task-based or self-reported) interacts with manipulated stress to predict both child-blaming attributions and harsh parenting behaviours.

In the following introductory sections, I briefly outline the theoretical basis of this study. Next, I review the literature on the associations between contextual sources of stress and harsh parenting, as well as the literature on associations between EF skills and harsh parenting. I also describe the potential moderating role of EF skills on the associations between stress and harsh parenting. Lastly, I describe additional gaps in the literature that I aimed to address within the current study.

1.1. Theoretical Framework

Belsky's (1984) process model on the determinants of parenting is an influential and overarching theory upon which much of the research and subsequent models of parenting are based. This model describes three overall domains of parenting determinants, including personal psychological resources, characteristics of the child, and contextual sources of stress and support. Each of these domains is seen as directly associated with parenting, as well as indirectly associated with parenting through transactional relations with each other. Importantly, this model

describes parenting as a 'buffered' system and ranks each of the domains in order of importance as a bulwark for adverse circumstances. Specifically, Belsky outlines that parental personal psychological resources are the most important buffer; if they remain intact under difficult circumstances, these psychological resources are able to mitigate negative effects of difficult circumstances, such as stress, on parenting. Therefore, Belsky's model provides an overall framework of relations and interactions among both internal and external determinants of parenting. Other theories focus in on specific pieces of these outlined relations.

Zooming in specifically on how stress might impact parenting, the family stress model posits that financial stressors lead to parental distress (e.g., parents feeling overwhelmed and unequipped to deal with external financial demands), which in turn impacts the quality of parenting behaviours and the time that parents spend with their children (Conger et al., 1992). While the original family stress model proposed that the experience of financial stress led parents to demonstrate less warmth and nurturance to their children, Conger et al. extended their model and also demonstrated associations between the experience of financial stress and the coercive interactions and harsh parenting described in Patterson's (1982) coercion theory (Conger, Ge, Elder, Lorenz, & Simons, 1994). They hypothesized that the experience of financial stress contributes to increased emotional arousal in parents, which "spills over" to reduce positive and increase negative interactions with children. Although this model focused specifically on financial stressors, it is plausible to assume that other events or experiences causing stress might evoke similar responses. For example, in a home with elevated levels of chaos (e.g., confusion, disorganization and time pressure), parents may feel overwhelmed and respond harshly to children, particularly in difficult parenting situations, such as when a child is misbehaving

(Dumas et al., 2005). Therefore, this model may be applicable across a range of stressors, including household chaos, and describes their associations with harsh parenting behaviours.

More contemporary research and parenting models reflect growing interest in the self-regulation and EF skills of parents. Although not explicitly stated in Belsky's (1984) model, parental EF skills are easily seen to fit the description of the domain of personal psychological resources as a determinant of parenting. Crandall et al. (2015) outline a conceptual model that delineates the processes described in Belsky's model and integrates parental EF and the family stress model. They hypothesized that both parental EF abilities and parental and family contexts (e.g., household chaos and low SES) are directly associated with each other and with parenting practices. In addition, they indicated that EF skills and contextual stressors interact in their associations with parenting. For instance, a mother with stronger EF abilities who experiences financial stress or chaos in the home may be better able to navigate and overcome the stressor with only minimal impact on her interactions with her children. Conversely, a mother with weaker EF capacities, who experiences the same stressor, may be less able to limit any negative spillover to her parenting.

The theoretical framework of the current study is based on an integration of these models, and in particular, on the associations among maternal EF skills, external stress, and harsh parenting, highlighted in grey in Figure 1. Aim 1 of this study focused specifically on Crandall et al.'s (2015) extension of Belsky's (1984) model and the family stress model (Conger et al., 1992), looking at the interaction between maternal EF skills and external stress (SES and household chaos) in predicting harsh parenting behaviours. Aim 2 of this study extended this research by addressing limitations of previous studies (e.g., correlational research designs). Specifically, I advanced previous relational research by manipulating stress and extending

measurement of parenting to include child-blaming attributions, parental cognitions that are closely associated with harsh parenting behaviours (Johnston & Ohan, 2005). In the following sections, I review the existing evidence supporting the associations highlighted in grey in Figure 1.

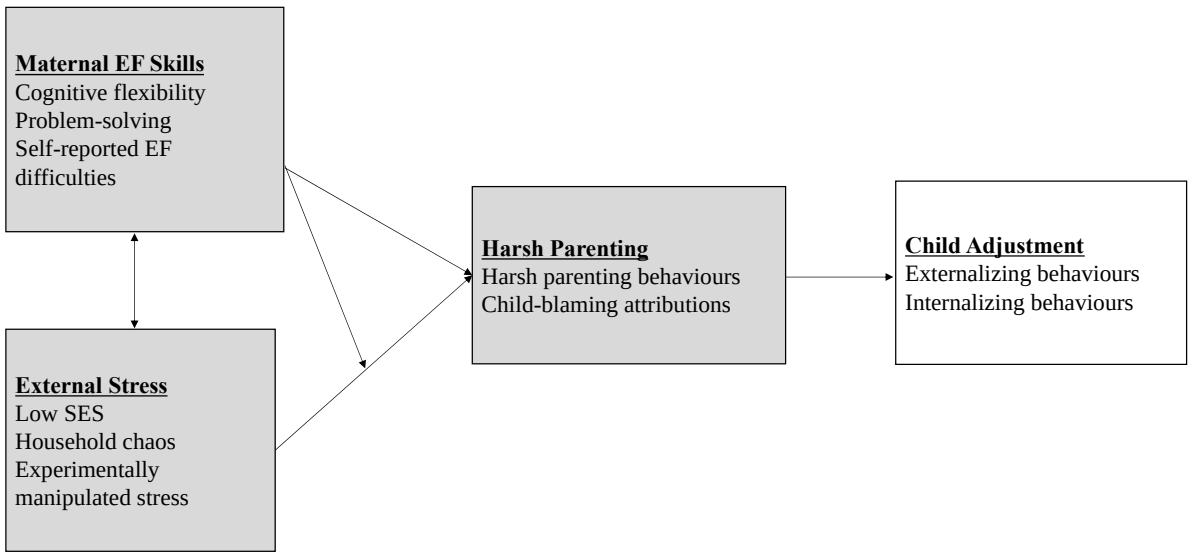

Figure 1. The theoretical framework for this study, based on Crandall et al.'s (2015) conceptual model.

1.2. Stress and Harsh Parenting Behaviours

All parents experience some form of stress in their lives. In the present study, I focus on maternal experiences of day-to-day stressors, and I conceptualize stress as the subjective experience arising when mothers feel that they are unable to cope with these stressors (i.e., as opposed to biological or physiological measures of stress). Stress, when conceptualized in this manner, can be caused by a variety of different stressors. Given its direct relevance to parenting, many studies have examined stress that is specific to the parenting role (e.g., challenges of difficult child behaviour, demands of caretaking), in relation to parenting behaviours. For

example, in a recent study, parenting stress was associated with mothers' child-blaming attributions, and these attributions accounted for the association between parenting stress and mothers' reports of harsh discipline (Beckerman, van Berkel, Mesman, & Alink, 2017). Other studies have demonstrated similar associations between parenting stress and harsh parenting behaviours (e.g., Anthony et al., 2005; Le, Fredman, & Feinberg, 2017; Liu & Wang, 2015). However, one limitation associated with examining parenting stress as a stressor is that the measurement of parenting stress often corresponds very closely with negative child behaviours. For example, descriptions of child behaviour problems often form the items of parenting stress questionnaires: "My child resists or struggles with me over bed-time" on the Parenting Daily Hassles Scale (Crnic & Greenberg, 1990), "My child makes more demands on me than most children" on the Parenting Stress Index (Abidin, 1990). The significant overlap between these two constructs makes it difficult to determine to what extent associations of parenting stress with parenting behaviours are confounded by associations with child behaviour problems. Therefore, in this study, I specifically examined stressors that are external to the parent-child relationship.

As noted in the previous section, contextual stressors commonly examined in the parenting literature include low SES and household chaos. Outlined in the family stress model (Conger et al., 1992), these stressors may contribute to harsher parenting through increased emotional arousal which then spills over into parent-child interactions through mediating variables such as parental motivation, cognition, and behaviour (Dix, 1991). More specifically, researchers hypothesize that the mechanism through which stress is associated with harsh parenting involves mothers' negative emotions (e.g., anger) resulting from stress, which decrease their motivation to engage in effective parenting behaviours, increase their negative child-blaming attributions, and lead them to engage in harsher parenting practices (Beckerman et al.,

2017; Dix, 1991; Milner, 1993). While the investigation of mechanisms linking stress and parenting are beyond the scope of this study, this model highlights the importance of contextual stressors such as low SES and household chaos in influencing parenting behaviours.

1.2.1. Socioeconomic Status (SES)

As described in the family stress model, parents in families of lower SES experience increased stress due to problems associated with economic hardship (e.g., low income, job instability) and are harsher in their parenting practices (Conger & Conger, 2002). There is a long history of research that has demonstrated support for the family stress model (e.g., Compas, 1987; Johnson, 1986). For example, many studies have demonstrated a link between poverty and child maltreatment (e.g., Eckenrode, Smith, McCarthy, & Dineen, 2014), and have found that abusive parents are more likely to have less education, lower income, and lower occupational levels compared to non-abusive parents (e.g., Euser et al., 2013; Whipple & Webster-Stratton, 1991). More directly examining this association, a longitudinal study that followed children from kindergarten to grade 3 demonstrated that SES predicted teacher- and peer-rated externalizing child problems, and this association was mediated by interviewer-rated maternal harsh parenting (Dodge, Pettit, & Bates, 1994). Furthermore, Grant et al.'s (2003) meta-analysis found that across 30 studies, there was a significant, small-to-medium association, between socioeconomic stress and harsh parenting behaviours (d = 0.48; Grant et al., 2003). In sum, there is a wealth of evidence, ranging from examination of more extreme cases of child abuse to consideration of more typically developing families, confirming that lower SES, as a stressor, is associated with harsher parenting behaviours.

1.2.2. Household Chaos

In contrast to SES, which is a broader and more systemic stressor, household chaos is more circumscribed and refers to an environment that is noisy, crowded, and lacking routine (Corapci & Wachs, 2002). Although it is correlated with SES, there is evidence that household chaos is a distinct construct and is associated with family variables above and beyond the associations with SES (Dumas et al., 2005). Studies have demonstrated links between household chaos and a variety of family outcomes such as decreased behavioural control in children (Vrijhof, van der Voort, Van IJzendoorn, & Euser, 2018), poor quality of coparenting (Whitesell, Teti, Crosby, & Kim, 2015), and negativity in the parent-child relationship (e.g., Kahn, Deater-Deckard, King-Casas, & Kim-Spoon, 2016; Nelson, O'Brien, Blankson, Calkins, & Keane, 2009). More specifically, and relevant to the current study, studies have demonstrated consistent links between household chaos and increased harsh parenting behaviours (e.g., Coldwell, Pike, & Dunn, 2006; Mills-Koonce et al., 2016; Pike, Atzaba-Poria, & Kretschmer, 2016; Zvara et al., 2014). For instance, household chaos was associated with mothers' reports of inconsistent discipline and their intention to utilize harsh parenting responses to children's negative emotions in a community sample of school-age children (Mokrova, O'Brien, Calkins, & Keane, 2010; Nelson et al., 2009). In another study, household chaos was associated with both maternal and paternal reports of harsh parenting (Coldwell et al., 2006). Similarly, in a longitudinal study of over 1,200 families (95% of participating parents were mothers), Mills-Koonce and colleagues (2016) demonstrated that household chaos measured across child ages 1-3 was associated with child callousness at age 6, a relation mediated through observed harsh parenting behaviours measured across ages 1-3. In sum, findings from this literature demonstrate that household chaos is associated with parents' harsh behaviours towards their children. Along with the literature

outlined above with regard to SES, this research confirms the hypothesized role of contextual sources of stress (lower SES and household chaos) as determinants of parenting as broadly outlined in Belsky's (1984) model of parenting.

1.3. Executive Functions and Harsh Parenting

It is clear from the above section that the links between the contextual factors of SES and household chaos (i.e., stress) and harsh parenting behaviours are well-established. In addition to these contextual factors, as described previously, Belsky's (1984) model of the determinants of parenting and Crandall et al.,'s (2015) extension of this model highlight the importance of personal factors, such as maternal EFs, in relation to parenting behaviours. EF is an umbrella term that refers to higher order thinking processes that enable planning, forethought, and goal-directed actions (Diamond, 2013). EFs allow individuals to navigate difficult situations by quickly shifting mind sets, adapting to situational change, monitoring behaviour, and inhibiting inappropriate behaviours (Jurado & Rosselli, 2007). There is a wealth of literature that demonstrates how EFs are important to just about every aspect of life, including physical health, quality of life, school success, job success, marital relationships, and public safety (see Diamond, 2013 for review). And now, an emerging line of research is investigating the link between EFs and parenting, across a variety of different EFs, and in relation to both harsh and positive parenting behaviours (see Crandall et al., 2015 for review). For example, Sturge-Apple, Jones, and Suor (2017) demonstrate direct links between mothers' EFs (assessed by working memory and inhibitory control) and how sensitively they respond to their child's behaviour measured observationally. Given that parenting places demands on parents' emotional and cognitive resources, it makes sense that EFs are helpful in allowing parents to navigate parenting situations successfully. Furthermore, as indicated in Crandall et al.'s (2015) conceptual model (Figure 1),

which is the basis of the current study, when parents experience external stress (e.g., from the demands of low SES or household chaos), it is predicted that parents with stronger EFs are better able to successfully navigate parenting situations compared to parents with weaker EFs.

Although it has been established that EFs play an important role in functioning, there is some confusion and debate surrounding the components and structure of EF (Karr et al., 2018). Some studies have identified three core EFs, which include cognitive flexibility, working memory and inhibition (Miyake et al., 2000), while others have identified a unitary, one-dimensional EF factor (e.g., Fleming, Heintzelman, & Bartholow, 2016). Most recently, Karr et al. (2018) re-analyzed previous studies examining the factor structure of EFs and found that a nested factor model showed modest support, reflecting both the unity and diversity of EF. This model specified a common, unidimensional EF factor as well as two specific factors, one that reflected tasks of shifting (i.e., cognitive flexibility) and one that involved tasks of updating (i.e., working memory). In the current study, I have chosen to examine EFs that reflect the themes of this most recent study. Because much of the previous literature has focused on working memory in association to parenting (e.g., Deater-Deckard, Sewell, Petrill, & Thompson, 2010; Sturge-Apple et al., 2014; Sturge-Apple et al., 2017), I aimed to extend the research by examining cognitive flexibility in association with parenting. In addition, to represent the overall unified EF construct, I included a measure of problem-solving skills, which is defined as a higher-level EF involving other EF skills, such as working memory and cognitive flexibility, working together in a collaborative fashion (Karr et al., 2018). In the following section, I first review the direct associations of these EFs with harsh parenting behaviours, and then describe evidence supporting their moderating roles, as well as some of the limitations surrounding the measurement of EF.

1.3.1. Cognitive Flexibility

Cognitive flexibility is a core EF, which involves the ability to shift flexibly between cognitive rules or modes of thought. Cognitive flexibility allows individuals to inhibit prepotent responses in favor of moving towards more adaptive responses. Deficits in cognitive flexibility may impact parenting by limiting maternal ability to monitor parenting behaviour and responses, leading to ineffective parenting decisions in the context of changing child cues. To illustrate this, one could imagine a mother who is taking an important work-related phone call from home and is interrupted by her child. Although her initial and usual inclination might be to reprimand her child, she may notice that her child is hungry and that it is nearing lunchtime and thus inhibit her harsh response, and instead calmly tells her child to wait. In this situation, this mother is likely using her cognitive flexibility skills to inhibit her prepotent response and take into consideration important situational changes or cues to help her to make a different, more positive, decision with regard to how she behaves towards her child. Conversely, a mother with poor cognitive flexibility skills might fail to take the situational factors into consideration and fail to shift from her initial response of harshly reprimanding her child.

Although it is hypothesized as an important EF with respect to parenting, the literature testing associations between cognitive flexibility and parenting is still young. In one of the few studies that examines this association, Azar, Stevenson, and Johnson (2012) demonstrated that mothers with child neglect histories demonstrated more cognitive inflexibility compared to mothers in the control group. Extending these findings, another study found that in the absence of strong cognitive flexibility skills, there was nothing to mitigate harsh parenting behaviours in response to child conduct problems (Deater-Deckard et al., 2012b). In contrast, the relationship between child conduct problems and harsh parenting behaviours was attenuated and

nonsignificant in mothers with strong cognitive flexibility skills, providing some support for the hypothesis that cognitive flexibility is an important EF skill that allows parents to respond more adaptively (i.e., less negatively) to difficult child behaviours. Another more recent study confirmed that parents who performed more poorly on a cognitive flexibility task also reported higher levels of strict and overprotective parenting (Kao, Nayak, Doan, & Tarullo, 2018). Similarly, Cuevas and colleagues (2014) demonstrated significant associations between maternal EF (a composite variable that included measures of cognitive flexibility) with harsh parenting behaviours. Therefore, although few in number, these studies provide preliminary support for the importance of cognitive flexibility in its association with harsh parenting behaviours.

1.3.2. Problem-solving

Problem-solving involves the ability to reason and see patterns among stimuli. It is considered a higher-order EF because other more core EFs, such as cognitive flexibility and working memory, are thought to contribute to problem-solving abilities (Diamond, 2013). A measure of problem-solving abilities may not only assess the unidimensional construct of EF, which is often demonstrated in factor analytic studies of the structure of EF (Karr et al., 2018), but may additionally assess the synergistic functioning of the core EFs. Problem-solving has been identified as an important skill with regard to parenting; adaptive parenting likely involves the ability to identify problems, weigh options, implement a plan, and revise decisions based on child outcomes (Sanders, Turner, & Metzler, 2019). More specifically, a mother with stronger problem-solving abilities may be better able to identify and assess patterns within a child-rearing situation, generate a variety of different solutions, and evaluate each solution before choosing the most adaptive option. Conversely, a mother with weaker problem-solving skills might have difficulty identifying the problem, have a narrower repertoire of solutions and be unable to

reason across these solutions, resulting in an inability to respond adaptively to difficult child-rearing situations (Azar, Robinson, Hekimian, & Twentyman, 1984).

Compared to cognitive flexibility, there is even less literature directly assessing mothers' problem-solving abilities and their relations to parenting behaviours. However, there is some evidence of this relation. For instance, in a study of grandparents raising their grandchildren, grandparents who reported using planful problem-solving strategies also reported fewer child behaviour difficulties in their grandchildren (Ross & Aday, 2006) and given well-established relations between parenting and child-behaviour problems, this study supports the possibility that problems-solving is associated with parenting behaviours. In an older study also examining this question, Azar and colleagues (1984) demonstrated that mothers who maltreated their children (both abuse and neglect) demonstrated poorer problem-solving skills compared to comparison mothers. In the previously described study by Deater-Deckard and colleagues (2012b), a measure of problem-solving also was included. Mirroring findings with cognitive flexibility, the researchers demonstrated that mothers who performed poorly on the problem-solving task responded to child conduct problems with harsher parenting. However, for mothers with above average performances on the problem-solving task, their problem-solving skills appeared to buffer their harsh parenting responses. Together, these studies implicate the importance of problem-solving abilities in mitigating harsh parenting behaviours. Not surprisingly, the findings for problem-solving are similar to those of cognitive flexibility, possibly due to the fact that they may overlap to some extent; that is, greater cognitive flexibility skills likely contribute to stronger problem-solving abilities. However, it is also true that the correlations between cognitive flexibility and problem-solving abilities are not perfect (e.g., Deater-Deckard & Bell, 2017; van Aken et al., 2014). Problem-solving skills may capture unique variance over and

above the core EFs, such as how efficiently and effectively mothers are able to apply their core EFs together to solve problems in the real world, making it an important EF to explore (Diamond, 2013).

1.3.3. Moderating Role of EF

In my review examining associations between cognitive flexibility and problem-solving with parenting behaviours, it is probable that both of these EFs play a role in child-rearing situations. That is, there is support for a direct association between maternal EF skills and parenting behaviours. It also is possible that EFs play a particularly important role under stressful circumstances. Mothers with stronger cognitive flexibility and problem-solving skills may be better able to manage the stressful demands of lower financial resources or living in chaotic homes and may in turn demonstrate less harsh parenting behaviours when confronted with challenging situations compared to mothers with lower EF abilities. In other words, although there is evidence that stress is associated with harsh parenting behaviour, this association may be attenuated when mothers have fewer EF difficulties (Belsky, 1984; Crandall et al., 2015). Several studies have examined this question but have demonstrated mixed findings with regard to the moderating role of EF.

Supporting the hypothesis that maternal EF buffers the effects of stress on parenting, Sturge-Apple and colleagues (2014) found a significant two-way interaction between SES and maternal EF (working memory) in predicting harsh discipline in a sample of mothers of 3.5-year-old children, such that there was a stronger association between low SES and harsh discipline in mothers with lower EF abilities compared to mothers with stronger EF abilities. Furthermore, they found a three-way interaction expanding upon this pattern such that maternal working memory capacity buffered the association between child-blaming attributions and harsh

parenting behaviours for mothers who were experiencing greater socioeconomic stress (low SES), while this buffering effect was not present for mothers experiencing less socioeconomic stress. However, this study only examined working memory as a measure of EF; it is not clear whether other EFs would demonstrate a similar stress-buffering pattern. Monn, Narayan, Kalstabakken, and Schubert (2017) addressed this question by including other measures of EF (e.g., problem-solving) in their study of mother-child dyads in the context of homelessness. They examined each EF controlling for the other EFs. In a similar direction as findings by Sturge-Apple and colleagues, they found that EF, specifically problem-solving abilities, moderated the association between perceived stress and observed harsh parenting behaviours.

In contrast, Deater-Deckard and colleagues (2012b) did not find the same pattern of findings. They utilized a composite variable of EF, that included measures of inhibition, cognitive flexibility, problem-solving, and working memory, and examined the moderating role of EF in the association between household chaos and harsh parenting behaviours. They found that there was no significant two-way interaction between household chaos and the composite EF variable in predicting maternal harsh parenting. Instead, they found a significant three-way interaction between household chaos, maternal EF, and child conduct problems. This interaction was such that in families living in homes with lower chaos, there was a two-way interaction between EF and child conduct problems (child problems were associated with harsh parenting only among mothers with poor EF), but in families living with higher chaos, the relation between child behaviour and harsh parenting was similar at both lower and higher levels of maternal EF. Therefore, the overall pattern of the interaction was inconsistent to that found in both the Sturge-Apple et al. (2014) and Monn et al. (2017) studies. Instead, these findings suggested that within high stress environments, EF is unable to mitigate the effects of stress on parenting.

There could be several possible reasons for this inconsistency. First, the Deater-Deckard et al. (2012b) study utilized a composite EF variable, while Sturge-Apple et al. (2014) only examined working memory, and Monn et al. (2017) examined each EF uniquely. Given the reliance on different methods of assessing EF, it is difficult to compare results across findings. Similarly, each of the studies utilized different indicators of stress (SES, household chaos, and perceived stress), making it difficult to compare their findings. However, it is notable that in an exploratory analysis, Deater-Deckard et al. replaced household chaos with SES and were unable to demonstrate interaction effects following the same patterns as demonstrated in the Sturge-Apple study. Relatedly, it is unclear whether the levels of stress or EF were comparable across studies. For example, mothers with the highest level of household chaos in the Deater-Deckard et al. study may have been experiencing more stress compared to mothers with the lowest level of SES in the Sturge-Apple et al. study, or vice versa. However, the fact that the Monn et al. sample included mothers living in particularly adverse circumstances (homelessness) and their results mirrored the findings from Sturge-Apple et al., which included a sample of mothers with relatively higher SES, suggests that these relations can be generalized across different socioeconomic contexts. It is clear that further replication of these findings is necessary to clarify the nature of the moderating role of EF, which is what I proposed in the first aim of the current study.

1.3.4. Conceptualization and Measurement Issues Pertaining to EF

As the research on EF and parenting increases, there are still several issues regarding the conceptualization and measurement of EF. One such issue is the previously mentioned debate surrounding the components and structure of EF (Karr et al., 2018). Reflecting the different lines of evidence with regard to the structure of EF, some studies examine each EF individually, or

while controlling for other EFs (e.g., Monn et al., 2017; Sturge-Apple et al., 2014) in line with theories indicating that there are separate core EFs (e.g., Miyake et al., 2000). Other studies utilize an overall EF composite score to combine across different tasks and skills (e.g., Deater-Deckard et al., 2012b), in line with research supporting a unidimensional structure of EF (e.g., Fleming et al., 2016). It is unclear at this time which option is more beneficial. Although examining each EF separately may delineate further the role of each type of EF and its unique contributions to parenting, I argue that the literature and theoretical models in this area are still young and do not yet offer unique hypotheses for different EFs with respect to parenting. For example, at this time, there is no reason to believe that working memory would moderate the association between stress and harsh parenting behaviours differently compared to the moderation offered by cognitive flexibility. Similarly, problem-solving, given that it is a higher-level EF involving both working memory and cognitive flexibility components, also is likely to work in the same direction. At the same time, the correlation between measures of core EFs and problem-solving abilities is not perfect (e.g., van Aken et al., 2014), and so it is possible that problem-solving abilities incrementally measure how mothers are able to utilize each core skill in conjunction with others to solve problems. Therefore, in this study, I utilized both cognitive flexibility and problem-solving abilities as my measures of EF. Given that I did not have specific hypotheses with regard to different functioning of these two EF skills, I allowed for the possibility of treating them separately if they appeared to be unique constructs, or combining across them to create a composite EF measure if this was empirically supported (i.e., if the two measures were significantly correlated, if they showed similar patterns of correlations with other measures).

Another issue within the larger EF literature is that, although purporting to measure the same construct, task-based measures of EF are largely uncorrelated with self-report or questionnaire measures of EF (Toplak, West, & Stanovich, 2013). Task-based measures of EF typically are based on the performance of individuals (e.g., accuracy, response time) on standardized tests. Self-report or questionnaire measures of EF typically ask the respondent to rate their own EF difficulties within their everyday lives, and theoretically, should correlate strongly with task-based measures of EF. However, Toplak and colleagues (2013) found that the majority of correlations (76%) reported in the literature were nonsignificant. This lack of correlations is curious and it is yet unknown which type of measure may be more valid or accurate in assessing EF. Although one benefit of task-based measures of EF is that they may be less influenced by response biases (e.g., impression management) than self-reports, others have argued that self-report measures of EF are superior given their higher predictive and ecological validity (e.g., Barkley & Fischer, 2011). Toplak and colleagues propose the interesting hypothesis that each of these methods of assessing EF tap into different aspects of functioning and that both have important real-world implications. More specifically, it is possible that task-based measures of EF assess the efficiency of EF under optimal conditions (i.e., highly standardized, quiet testing conditions where participants are given clear instructions), while self-report measures of EF tap into how individuals perform in everyday situations (i.e., where there may be various demands placed on the individual). Based on the argued unique importance of both methods of measurement, the current study included a self-report measure of EF along with task-based measures of cognitive flexibility and problem-solving.

1.4. Additional Gaps in the Current Literature

1.4.1. Confirming the Role of Stress

As outlined above, the links between both SES and household chaos and harsh parenting behaviours have been well-researched and established. However, one of the main limitations of this research is the assumption that stress is the main mechanism through which SES and household chaos are associated with parenting. There are a variety of mechanisms by which SES may be associated with parenting behaviours, such as through a lack of resources or less education and knowledge about parenting (Bornstein, Cote, Haynes, Hahn, & Park, 2010). Because SES is such a broad construct that could influence or reflect many facets of a parent's life other than their perceived stress, it is difficult to determine from correlational designs to what degree the association of SES and parenting is representative of a unique association between stress and parenting.

As with SES, stress is proposed to be one mechanism through which household chaos has its impact on parenting (Mills-Koonce et al., 2016). This is supported by research demonstrating that components of household chaos are associated with increases in biological markers of stress (e.g., DeCaro & Worthman, 2011; Huang et al., 2013), as well as reported perceived stress (e.g., Evans, Hygge, & Bullinger, 1995). It is possible that mothers who experience greater household chaos experience greater stress, which in turn negatively affects parenting behaviours. However, similar to the issues outlined for studies linking SES to parenting behaviours, studies examining associations between household chaos and parenting behaviours do not directly test the hypothesized role of stress.

One solution to this issue is to directly measure mothers' levels of perceived stress. Studies that have done so have generally demonstrated similar findings to those found for SES

and household chaos (e.g., Monn et al., 2017; Rodgers, 1998). For example, Rodriguez (2010) utilized a questionnaire measure of stress that assessed experienced stress in relation to parenting as well as other types of general stress such as financial strain, in mothers of children below the age of 12 and found that stress was positively associated with harsh parenting behaviours. Another more recent study utilized diary data of mothers' daily stressors (including work stress, home stress, and relationship stress) and parent-child conflict collected over seven days and found that mothers reported greater conflictual interactions with their children on days they experienced greater levels of stress (Nelson, Boyer, Villarreal, & Smith, 2017). Despite these compelling findings, these studies still employed a correlational design, making it difficult to confirm causal relations between stress and parenting.

Therefore, the limitations of the reviewed studies on stress and parenting are twofold: 1) most do not measure stress directly, and 2) even if they do utilize a measure of perceived stress, almost all of these studies employ correlational designs making it impossible to determine whether stress causes harsh parenting behaviours, or whether the association runs in the opposite direction or is caused by a third, unmeasured variable. Only a few studies have attempted to directly manipulate and assess the effect of stress on parenting behaviours using experimental designs. Perhaps the first of these studies was by Schellenbach and colleagues, who examined the impact of situational stress on harsh parenting behaviours (Schellenbach, Monroe, & Merluzzi, 1991). They did so by altering vignettes such that mothers (n = 16) read both low stress vignettes (e.g., relaxing on vacation) and high stress vignettes (e.g., recent loss of job) describing child misbehaviours. They found that in high stress compared to low stress situations, mothers who were at risk for child abuse reported they would use harsher parenting behaviours. Krech and Johnston (1992) also utilized vignettes of child behaviour and integrated descriptions

of major stressors (e.g., family health issues, financial issues), descriptions of minor daily stressors (e.g., parking ticket, car making strange noises), or no stressors into the vignettes. They found that mothers perceived child behaviour to be more problematic and indicated that they would have a harsher parenting response when reading vignettes in the minor daily stress condition compared to the other conditions. Although the benefit of using these vignettes was that it allowed researchers to hold child behaviour and stressors consistent across mothers, it may not have been a realistic and externally valid manipulation of stress. That is, it is not clear how well mothers were able to imagine themselves in a stressful situation, and how accurately they were able to report on how they would respond in a child-rearing situation when actually experiencing the stressor.

In contrast, other studies have examined the impact of stress by exposing mothers to video or audio recordings of an infant crying (presumed stressor). For instance, studies have assessed maternal physiological reactivity in response to the infant crying stimuli and found that mothers who showed signs of harsh parenting behaviours or were at risk for child maltreatment demonstrated different patterns of physiological reactivity to infant cries compared to mothers who were not at risk (e.g., Joosen, Mesman, Bakermans-Kranenburg, & IJzendoorn, 2013; Reijman et al., 2014). However, studies that have used the infant crying stimuli in an experimental design, comparing exposure to infant crying versus a control condition, found no effects of crying on parenting behaviours (e.g., Caselles & Milner, 2000; De Paúl, Asla, Pérez-Albéniz, & De Cádiz, 2006). It is possible that the infant crying paradigm was limited as an experimental manipulation of stress because the stimuli were typically not the parent's own child, or because participants were typically mothers of older children for whom a crying infant may no longer be a relevant stressor. In partial support of this possibility, one study examined the

physiological effect of exposure to a crying infant video among mothers (their child's ages were not reported), and found no change in heart rate across the experimental (infant crying) and control conditions (infant smiling), although there was some evidence of elevated skin conductance in response to the crying (Casanova, Domanic, McCanne, & Milner, 1994). In sum, although the infant crying paradigm may produce differentiating physiological responses in mothers who are at risk for child maltreatment, it has not been established as a fully valid or reliable manipulation of stress for all mothers. In addition, it is difficult to make conclusions about the effects of stress on parenting when an infant crying paradigm is used because, as with parenting stress, this stressor confounds stress and child difficulties.

In contrast to vignettes and to the infant crying paradigm, the Trier Social Stress Task (TSST; Kirschbaum, Pirke, & Hellhammer, 1993) reliably activates the hypothalamic-pituitary-adrenal axis response, which is the core neurobiological response to stress. The TSST involves two key psychological elements that have been shown to produce the greatest stress responses: 1) social-evaluative threat and 2) uncontrollability (Dickerson & Kemeny, 2004). Specifically, in the TSST procedure, participants are given time to prepare for a job application speech. They are then brought in front of a panel of interviewers and video cameras (social evaluative threat), where they are asked to give the 5-minute speech, and, in addition, are surprised with 5 minutes of a difficult mental arithmetic task (uncontrollability; Kirschbaum et al., 1993). Of all laboratory stressors, the TSST has been identified as the one that elicits the highest cortisol and adrenergic response (both of which are elements of a biological stress response; Dickerson & Kemeny, 2004). Countless studies have utilized the TSST procedure and have allowed researchers to examine procedural modifications that produce the largest stress response (see Goodman, Janson, & Wolf, 2017 for review). Moreover, the TSST has been utilized to demonstrate

significant impacts of stress on a variety of psychological concepts such as EFs (Shields, Sazma, & Yonelinas, 2016), decision making (Starcke & Brand, 2016), and learning (Fournier, d'Arripe-Longueville, & Radel, 2017).

When considering the use of TSST with mothers, not only is it one of the most reliable laboratory stress tasks, it also is likely to be ecologically valid, especially as most mothers are working outside of the home. In Canada, approximately 75% of families with at least one child under 16 include a mother who is employed (Statistics Canada, 2014). Furthermore, the TSST involves stress that is external to the parent-child relationship, which allows for more general conclusions about the effects of stress on parenting (i.e., as opposed to parenting stress or the infant crying paradigm). However, to my knowledge, no studies exist that have examined the effect of stress, as induced by the TSST, on parenting behaviours. Therefore, in my second aim, I examined the effect of stress on mothers' harsh parenting behaviours using the TSST procedure, serving to extend extant findings of associations between SES, household chaos, and questionnaire measures of stress and parenting behaviours by examining stress directly, and by addressing the limitations of previous correlational studies through experimental manipulation.

1.4.2. Parental Cognitions

Thus far, as I have reviewed, much of the research on the moderating role of EF on the association between stress and parenting has focused on harsh parenting behaviours. However, the important role of parental cognitions is becoming apparent, particularly as a precursor to harsh parenting behaviours (Johnston & Ohan, 2005). For example, a longitudinal study of a community sample of 4-6-year old children demonstrated that mothers' more negative child-blaming attributions predicted children's future externalizing behaviour over a 4-year period, and this relation was mediated by interviewer- and spouse-rated maternal harsh discipline behaviour

(Nix et al., 1999). Other longitudinal and experimental studies have produced similar findings across both clinical and community samples (e.g., Johnston, Hommersen, & Seipp, 2009; Smith Slep & O'Leary, 1998) and highlight the importance of child-blaming attributions in their associations with harsh parenting behaviours. However, given that research on the interaction between stress and EF in relation to harsh parenting behaviours is still relatively new, even less is known about how stress and EF may interact in relation to these child-blaming attributions.

Theoretical models outline how the experience of stress and lower EF skills may impact moment-to-moment parent-child interactions through parental attributions and intentions. For instance, the social information processing model (Milner, 1993) describes that in response to child behaviour (e.g., spilling milk on the floor), parents form attributions or explanations for the behaviour (e.g., that the child spilt the milk on purpose), and these cognitions then influence how they respond to the child (e.g., a harsh reprimand). Dual-process models of cognition (Andersen, Moskowitz, Blair, & Nosek, 2007) extend this model by suggesting that for many parents, their initial, automatic attributions may be child-blaming in response to child misbehaviour. However, top-down information processing abilities (i.e., EFs) are proposed to allow parents to override these initial negative attributions, if they are motivated to do so, by considering mitigating information (e.g., the child is tired) or their own parenting goals (e.g., parental kindness is important; Johnston, Park, & Miller, 2019). These models imply an effortful and conscious processing of information that is subject to disruption by the experience of stress (e.g., Pinderhughes, Dodge, Bates, Pettit, & Zelli, 2000; Wang, Deater-Deckard, & Bell, 2013) or poor EF skills (e.g., Azar, McGuier, Miller, Hernandez-Mekonnen, & Johnson, 2017). At the same time, if stress taxes higher-order thinking processes, it is possible that stress and EF may interact such that mothers with stronger EF skills might be better able to manage and navigate the effects

of stress on child-blaming attributions. For instance, in the illustration above, if the mother is both stressed (e.g., preparing for a difficult presentation at work) and has poorer EF skills, she may find it even more difficult to override or correct any initial negative attributions (that the child spilled the milk on purpose). In contrast a mother with stronger EF skills may be better able to consider the mitigating factors and reduce child-blaming attributions despite the experience of stress. Therefore, in the second aim of the current study, I extended the current literature by also examining the associations and interactions among experimentally manipulated stress and EF with child-blaming attributions along with harsh parenting behaviours.

2. Aim 1

In summary, Crandall et al.'s (2015) conceptual model has updated previous theories to posit that both EF and stress are directly associated with parenting behaviours, and additionally, that they may interact in their associations with parenting behaviours. Research findings confirm these posited direct associations: the relations between stress (as assessed by SES and household chaos) and harsh parenting behaviours have been well established (e.g., Grant et al., 2003; Mills-Koonce et al., 2016), and there is increasing research demonstrating negative associations between EFs such as cognitive flexibility and problem-solving abilities with harsh parenting behaviours (e.g., Deater-Deckard et al., 2012b; Kao et al., 2018). However, there are somewhat inconsistent findings with regard to the moderating role of EF on the association between stress and harsh parenting behaviours. Sturge-Apple et al. (2014) and Monn et al. (2017) both found that maternal EF buffers the associations between stress and harsh parenting behaviours, however Deater-Deckard et al. (2012b) found that EF attenuated the association between child conduct problems and harsh parenting behaviours in families living in low chaos household, but not in families living in high chaos households.

Given these inconsistent findings, I aimed to replicate previous studies to first demonstrate significant associations between stress and maternal EF with harsh parenting behaviours, and then to test the moderating role of EF in the associations between stress and harsh parenting behaviours. Furthermore, I extended previous research by including not only task-based measures of EF, but also including self-reported EF difficulties. As such, the research questions for the first aim of this study were:

1) Is there a direct association between stress variables and harsh parenting behaviours?

2) Is there a direct association between maternal EF (assessed using EF tasks and self-report) and harsh parenting behaviours?
3) Is the interaction between stress and maternal EF (assessed using EF tasks and self-report) significantly associated with harsh parenting behaviours over and above their main effects?

Based on the previously reviewed research (e.g., Kao et al., 2018; Mills-Koonce et al., 2016), I hypothesized that both stress and maternal EF would be directly associated with harsh parenting behaviours. Additionally, based on previous research by Sturge-Apple et al. (2014) and Monn et al. (2017) and Belsky's (1984) theoretical model, I hypothesized that mothers' EF skills would buffer the associations between SES and harsh parenting behaviours, and between household chaos and harsh parenting behaviours.

Potential Covariates/Confounds

Because the associations between stress variables, EF variables, and harsh parenting behaviours were correlational in nature, I ensured that the tested relations were not a proxy of external, confounding variables by examining relevant demographic, child, and parent characteristics and controlling for these if they demonstrated significant relations with the constructs of interest.

First, I examined child age as a potential confound due to evidence that parenting demands change as children grow older, and parents discipline differently depending on their child's age (e.g., Blacher & Feinfield, 2013). I also examined child gender as a potential confound based on evidence that parents socialize their sons and daughters differently (e.g., Leaper & Farkas, 2015). Furthermore, when assessing harsh parenting behaviours, it is important

to consider the potential confounding influence of the experiences that each mother has with her own child. I controlled for this by assessing maternal reports of their own child's misbehaviour.

With regard to parent characteristics, although there is some evidence that intelligence and EFs are correlated, studies have mostly demonstrated that these are distinct and independent constructs (e.g., Ardila, Pineda, & Rosselli, 2000; Friedman et al., 2006). In the parenting literature, when EF and intelligence are both examined, links between EF and parenting behaviours have been demonstrated over and above the relations with maternal intelligence (Deater-Deckard et al., 2010). However, because these are interrelated concepts, and as recommended by previous reviews (e.g., Crandall et al., 2015), I examined maternal intelligence, assessed by a measure of verbal intelligence, as a possible covariate. Lastly, many studies demonstrated that parents experiencing more symptoms of depression, anxiety, or antisocial behaviours also demonstrated more negative parenting behaviours (Klahr et al., 2016; Lovejoy, Graczyk, O'Hare, & Neuman, 2000) and greater EF difficulties (Nigg et al., 2017; Snyder, 2013; Snyder, Miyake, & Hankin, 2015). As a result, maternal psychopathology was examined as a potential covariate.

2.1. Method: Aim 1

2.1.1. Participants

Power calculations were conducted using the G*Power 3 program (Faul, Erdfelder, Lang, & Buchner, 2007) prior to data collection. Based on previous studies examining these associations (e.g., Deater-Deckard et al., 2012b; Sturge-Apple et al., 2014), a sample size of 100 was deemed adequate based on a predicted small-to-medium effect size, an alpha level of .05, power of .80, and seven predictors. As a result, one hundred and seven mothers of 6-10-year-old girls and boys were recruited throughout Vancouver, Canada, using advertisements in

community centers, income assistance offices, elementary schools, medical centers, social media, classified advertisement websites, and a volunteer registry of families interested in research. Three mothers were excluded from analysis: one who was unable to finish the study in the allotted time due to language difficulties, and two who withdrew from the study. One hundred and four mothers were retained for the final sample. The demographic information of participating mothers is presented in Table 1.

Table 1. Demographic characteristics of the sample.

Demographic Variable	Total (N = 104)	
	N	M (SD) or %
Child Gender		
Female	56	53.8
Age (Years)		
Child	-	7.98 (1.35)
Mother	-	40.49 (5.04)
Marital Status		
Married/Common Law	87	83.7
Divorced/Separated	12	11.5
Single	4	3.8
Missing	1	1.0
Mother's Ethnicity		
European/North American	46	44.2
East Asian	27	26.0
Other	29	27.9
Missing	2	1.9
Degree of Acculturation[a]	-	7.17 (3.09)
Mother's Education		
Graduate or Professional Training	30	28.8
Standard College/University	48	46.2
Partial College/University or Special Training	17	16.3
High School Graduate	5	4.8
Less than High School	3	2.9
Mother Employed		
Yes	58	55.2

Demographic Variable	Total (N = 104)	
	N	M (SD) or %
Household Income		
Less than $5,000	2	1.9
$5,000-$19,999	9	8.7
$20,000-$34,999	8	7.7
$35,000-$49,999	4	3.8
$50,000-$74,999	19	18.3
$75,000-$99,999	19	18.3
$100,000-$149,999	19	18.3
$150,000-$199,999	12	11.5
$200,000 and Higher	8	7.7
Missing	4	3.8

Note. [a]Degree of acculturation was assessed by asking mothers how much they identified as Canadian on a 1 (*not at all*) to 10 (*completely)* Likert scale.

On average, mothers in the study were approximately 40-years-old and had a child of approximately 8 years of age. The majority of mothers were married, employed, and highly educated (75% of mothers endorsed a university degree or higher). The average household income was in the $50,000 to $74,999 range. The sample was ethnically diverse and reflective of the ethnic representation in Vancouver (Statistics Canada, 2017b).

2.1.2. Measures

Harsh parenting behaviour (dependent variable [DV]).

Harsh parenting behaviour was assessed using the punitiveness subscale from the Parenting Practices Inventory (PPI), which is a measure initially developed for the Fast Track Project (Conduct Problems Prevention Research Group [CPPRG], 1996). The overall scale includes 17 items that assesses the effectiveness, consistency, and punitiveness of parents' discipline efforts. The items are coded on a 4-point scale (1 = *never* to 4 = *often*), with higher scores indicating harsher parenting behaviours. The punitiveness subscale includes five items and has demonstrated adequate reliability (Miller-Johnson & Maumary-Gremaud, 1995) and validity (e.g., high intercorrelations with child externalizing behaviours, Lochman & CPPRG, 1995). In the current sample, the internal consistency of the five-item punitiveness subscale was

.67. Examination of individual items indicated that one ("If you punish your child, how often does his/her behaviour get worse?") had relatively weak correlations with other items in the subscale. Furthermore, this item was unique; although the other four items describe mothers' behaviour (e.g., "When your child does something wrong, how often do you lose your temper towards him/her", "How often do you have to spank your child?", "How often do you yell at your child?", and "How often do you have to threaten your child with punishment in order to get him/her to do something?"), this item appears to additionally assess the child's response to the mother's parenting behaviours. Removal of this item increased internal consistency to .74. Due to both conceptual and empirical reasons, I removed this item from the subscale composition.

Stress variables.

Household Chaos. Mothers completed the Confusion, Hubbub and Order Scale (CHAOS; Matheny, Wachs, Ludwig, & Phillips, 1995) as a measure of household chaos. This scale consists of fifteen items rated on a 4-point scale (1 = *definitely untrue* to 4 = *definitely true*). Higher scores indicate higher levels of household chaos. Examples of included items are, "We are usually able to stay on top of things" (reverse scored) and "You can't hear yourself think in our home." A total score was generated by averaging across all the items. This scale has been utilized in previous studies examining parenting behaviours and home chaos, and has demonstrated good validity and reliability (Coldwell et al., 2006; Matheny et al., 1995). In the current sample, the internal consistency was good, Cronbach's $\alpha = .85$.

SES. SES was determined using the Hollingshead (1975) Four-Factor Index of Social Status. This score is calculated with consideration of marital status, occupation, and education. Mothers' and, if relevant, their partners' occupations were coded into Occupational Factor categories by two coders (ICC = .80 for mothers, and .90 for partners). If a mother was not

employed, then SES was calculated as a sum of her partner's occupation score (multiplied by a factor of 5) and education score (multiplied by a factor of 3). If a mother was single or divorced, SES was calculated as a sum of her occupation score (multiplied by a factor of 5) and education score (multiplied by a factor of 3). If a mother and her partner were both employed, then each individual's scores were calculated as above, then averaged to represent the family's SES. The raw Hollingshead score was utilized as the measure for SES in this study, with higher scores indicating higher SES.

Task-based EF skills.

Cognitive Inflexibility. As a measure of cognitive inflexibility, mothers completed the Wisconsin Cart Sorting Test (WCST; Grant & Berg, 1948). Mothers were presented with 128 trials of four cards displaying different shapes, colors and numbers. Their task was to match a stimulus card to one of these four cards using feedback about whether they were correct or incorrect in their matching choice (see Figure 2). After 10 trials of cards were correctly sorted, the sorting principle was switched, although mothers were not explicitly told of the switch and needed to use corrective feedback to determine the new principle. For example, if the sorting principle was shape, if a mother received a stimulus card with two blue circles and attempted to match to number (i.e., choosing the card with two green triangles), she received feedback that this was incorrect. If on the next trial, she sorted the stimulus card to shape (i.e., the card with one red circle), she received feedback that this was correct. She was then able to surmise that the

sorting principle was shape. After successfully sorting 10 cards according to this principle, she received feedback of "incorrect" and needed to determine the new sorting principle.

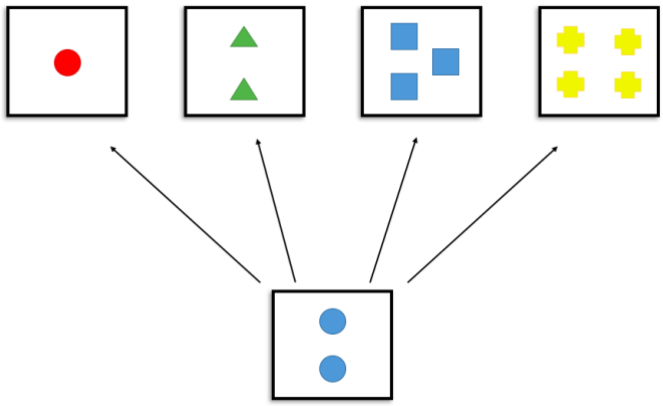

Figure 2. The Wisconsin Card Sorting Task

Typically, the total percentage of perseverative errors (i.e., the number of mistakes made by continuing to use the incorrect matching principle per total number of trials administered) is utilized as the score for cognitive inflexibility (Heaton, Chelune, Talley, Kay, & Curtiss, 1993). However, a problem arose in using this score in the present sample. Some mothers had low percentages of perseverative errors, however, they also had a low number of principle changes, indicating that it may have taken these mothers many trials to understand the task. These mothers made many non-perseverative errors (e.g., mistakes that were not associated with the previous matching principle) before they discovered the correct sorting principle. Compared to mothers who understood the task from the start, these mothers with fewer principle changes had a smaller sample of trials to make perseverative errors, and therefore their percentage of perseverative errors was downwardly biased. This difficulty with understanding may have been because the WCST was administered as a computer task, and research assistants were not present in the room to provide clarifications or to verbally explain the task. As a consequence of the fact that some mothers had few principle changes, the usual method of score calculation was deemed a poor

representation of cognitive inflexibility in the current sample. Instead, to account for the number of principle switches and to correct bias in the percent perseverative error score, I calculated a score for cognitive inflexibility which divided the total number of perseverative errors by the number of principle switches. Higher scores on this measure indicated greater cognitive inflexibility (i.e., that mothers made more perseverative errors per switch in principle). Scores of 0 indicated that mothers made no perseverative errors per switch in principle.[1]

The WCST is a well-established measure of EF and is one of the most frequently utilized measures, both clinically and in research (Greve, Stickle, Love, Bianchini, & Stanford, 2005). The WCST has demonstrated good validity (e.g., the ability to discriminated between patients who suffered from a stroke and normal controls; Su, Lin, Kwan, & Guo, 2008). Evidence for the validity of the cognitive inflexibility score derived from the WCST in the current sample included that the cognitive inflexibility score was significantly correlated with another EF measure (the Matrix Reasoning score from the WASI), $r(93)^2 = -.38$, $p < .001$, such that cognitive inflexibility was associated with weaker problem-solving skills. As well, cognitive inflexibility was significantly associated with less maternal education, $r\ (93) = -.35$, $p = .001$.

In contrast to its validity, the test-retest reliability for the WCST is not strong (.62; Calamia, Markon, & Tranel, 2013) due to practice effects, which are seen up to 7 years (Calamia, Markon, & Tranel, 2012; Jurado & Rosselli, 2007). To ensure practice effects were not inflating maternal scores in the present study, I asked mothers whether they had previous experience with the WCST. Six mothers indicated that they had completed the WCST previously and their scores on this task were omitted. Additional faulty or potentially invalid scores were

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[1] Evidence for the validity of this method of score calculation for the WCST is presented in the next paragraph.
[2] The smaller *n* compared to the total sample size is due to the exclusion of faulty or invalid scores as described in the next paragraph.

identified if mothers did not achieve at least one shift in sorting principle throughout the duration of the task. These mothers' scores were omitted, as this implied that they were unable to correctly identify the first sorting principle across 128 trials and therefore did not understand the task (n = 4).

Problem Solving Skills. As a measure of problem-solving skills, mothers were administered the Matrix Reasoning subtest from the Wechsler Abbreviated Scale of Intelligence-II (WASI-II; Wechsler, 2011). In this task, mothers were presented with an incomplete matrix or series of stimuli, and they were asked to select the correct response from five different options to complete the matrix or series. Mothers were presented with up to 30 items that progressed in difficulty. The subtest was discontinued once mothers incorrectly answered three consecutive items. Scores on this subtest were calculated as the sum of correct responses converted into T-scores using normative data according to age group. Higher T-scores indicated stronger problem-solving skills.

Although the Matrix Reasoning subtest is traditionally considered a measure of fluid intelligence, researchers have argued that the definitions of executive functions and fluid intelligence share a common element in describing the use of strategies to reason and solve novel problems (Decker, Hill, & Dean, 2007) and that fluid reasoning, as assessed by tasks such as the Matrix Reasoning subtest, can be considered a measure of higher-level executive functions (e.g., reasoning, problem solving and planning; Diamond, 2013). Furthermore, factor analytic studies have demonstrated that the Matrix Reasoning subtest loads with other tests of executive functions, such as the WCST and the Stroop test (van Aken, Kessels, Wingbermühle, van der Veld, & Egger, 2016; van Aken et al., 2014). In an adult sample, the split-half reliability of the Matrix Reasoning subtest was excellent (> .90) and the test-retest reliability was good (> .83;

Wechsler, 2011). The split-half reliability of the Matrix Reasoning subtest in this sample was good (.85). Evidence for the validity of this problem solving measure in the current study was demonstrated in its significant correlation with the cognitive inflexibility score (noted above), as well as its correlation with higher maternal education, $r(101) = .32$, $p = .001$.

Composite Task-Based EF Skills. Due to the significant correlation between the two task-based measures of EF, as well as their similar patterns of associations with other variables examined in this study[3], these variables were standardized and combined (after reversing the cognitive inflexibility score to a cognitive flexibility score) to create a composite task-based EF score. For mothers with scores on only one of these measures (e.g., mothers whose scores were invalid on the WCST), their score on the other task served as their overall composite task-based EF score. This composite task-based EF skills score was utilized in an effort to reduce the number of total analyses across the current study.

Self-reported EF difficulties.

Mothers' self-reported EF difficulties were assessed using the Behaviour Rating Inventory of Executive Function-Adult Version (BRIEF-A; Roth, Isquith, & Gioia, 2005). The BRIEF-A consists of 75 items assessing mothers' perceptions of their executive functioning difficulties during the past 6 months. Examples of items include, "I make careless errors when completing tasks", "I am disorganized", and "I have trouble changing from one activity or task to another". Each item is rated on a 3-point scale (1 = *Never* to 3 = *Often*). The BRIEF-A has demonstrated good internal consistency and test-retest reliability in both clinic and non-clinic

[3] Cognitive flexibility and problem-solving were each nonsignificantly associated with harsh parenting practices, household chaos, self-reported EF, maternal psychological symptoms, and child behaviour problems (*r*s = -.18 to -.003, *p*s > .05). They were significantly associated with verbal cognitive ability, maternal education, and SES (this association was marginal for maternal problem-solving), all in the same direction (*r*s = .22 to .35, *p*s < .05)

samples and scores on the BRIEF-A correlate significantly with other questionnaire measures of EF (Roth et al., 2005). All 75 items were summed to form a composite index score, called the Global Executive Composite (GEC), which was utilized in the current study. The internal consistency for the GEC was excellent in the current sample, Cronbach's $\alpha = .97$.

Other measures and potential covariates.

Participant Demographics. Mothers completed a questionnaire asking about their basic demographic information, such as family members' age, gender, ethnicity, education level, mothers' and fathers' employment and marital status. These variables were used to describe the sample and were examined as potential covariates in my analyses.

Verbal Cognitive Ability. To examine whether verbal cognitive ability, or verbal intelligence, accounted for any associations with maternal EF, I utilized the Vocabulary subtest from the WASI-II (Wechsler, 2011) as a brief and reliable measure of maternal verbal cognitive ability. On this subtest, mothers were asked to provide definitions to words of increasing difficulty. Their answers were given scores of 2, 1, or 0 depending on completeness and accuracy. Items were administered until mothers reached a discontinuation criterion of three consecutive scores of zero or they reached the last item. Mothers' scores, out of 62, were then converted into T-scores, and used to estimate cognitive ability.

Maternal Psychopathology. I examined maternal psychopathology as a covariate due to research suggesting that it is associated with parenting behaviours, EF and stress (e.g., Klahr et al., 2016; Lovejoy et al., 2000; Nigg et al., 2017). Maternal depression, hostility, and anxiety symptoms were assessed using the Brief Symptom Inventory (BSI; Derogatis, 1993). Items of the Depression, Hostility, and Anxiety subscales on the BSI are rated on a 5-point Likert scale (0 = *Not at all* to 4 = *Extremely*). The Depression subscale includes six items measuring symptoms

such as, “Feeling blue” and “Feeling hopeless about the future”. The Hostility subscale is made up of five symptoms that assess thoughts, feelings or behaviours characteristic of anger. Examples of items include, “Feeling easily annoyed or irritated” and “Having urges to break or smash things”. The Anxiety subscale includes six items that assess symptoms of nervousness, tension, and panic attacks (e.g., “Nervousness or shakiness inside”, and “Feeling tense or keyed up”). All three subscales have demonstrated good internal consistency, test-retest reliability, and concurrent validity (Derogatis, 1993). In the current sample, the internal consistency for each subscale was good (Anxiety Cronbach’s $\alpha = .82$; Depression Cronbach’s $\alpha = .85$; Hostility Cronbach’s $\alpha = .73$). Furthermore, given the high correlations among the three subscales, $r(103) = .52$ to .75, they were combined to form a composite maternal psychological symptoms variable, which also demonstrated good internal consistency (Cronbach’s $\alpha = .82$).

Child Behaviour Problems. To account and control for the potential influence of each mother’s own child in my analysis, the Strengths and Difficulties Questionnaire (SDQ; Goodman, 2001) was used to assess the behaviour of the mother’s own child. The SDQ assesses five dimensions of child behaviour including Hyperactivity (e.g., “Restless, overactive, cannot stay still for long”), Emotional Symptoms (e.g., “Many worries, often seems worried”), Conduct Problems (e.g., “Often lies or cheats”), Peer Problems (e.g., “Rather solitary, tends to play alone”), and Prosocial Behaviour (e.g., “Considerate of other people’s feelings”). The Hyperactivity, Emotional Symptoms, Conduct Problems, and Peer Problems subscales were averaged to create a Total Difficulties score, which has demonstrated good internal consistency and test-retest reliability (Stone, Otten, Engels, Vermulst, & Janssens, 2010). In addition, the SDQ has demonstrated good concurrent validity and predictive validity discriminating between

psychiatric and non-psychiatric populations (Goodman, 2001). In the current sample, the internal consistency of the composite total difficulties score was good, Cronbach's $\alpha = .74$.

2.1.3. Procedure

The study was approved by the University Behavioural Research Ethics Board. The study was advertised as a study about parenting and communication skills. When interested mothers contacted the laboratory, they completed a brief screening questionnaire to determine eligibility. If mothers were deemed eligible to participate, they were provided with an electronic copy of the consent form and were scheduled for a laboratory visit. Upon arrival at the lab, research assistants greeted mothers and explained study procedures. Mothers signed the consent form and completed the study in three subsequent blocks.

In the first block, mothers completed the parenting and child-related questionnaires, including the SDQ, the PPI, as well as other parenting measures (not examined in the current study) in a randomized order. In the next block, mothers first completed the computerized version of the WCST, and then a research assistant administered the Vocabulary and the Matrix Reasoning subtests in the WASI-II.[4] In the last block, mothers completed another set of questionnaires, including the demographics questionnaire, as well as the CHAOS, the BSI, the BRIEF-A, and other questionnaires that were not utilized in the current study. Next, they completed procedures for Aim 2, described below, before being provided with a debrief of the study, a list of parenting resources, and a $50 honorarium.

[4] Two additional EF tasks were also administered at this time, a Letter Number Sequencing Task and a Two-Choice Impulsivity Task. However, due to technical/computer errors, the scores from these tasks were not considered valid and were not utilized in the study.

2.1.4. Data Analytic Plan

Data screening and preliminary analyses.

Descriptive statistics for each variable were examined and reported. Data were screened for outliers and missing variables. Results were compared when outliers were included versus if they were truncated to determine if inclusion of outliers altered findings. Missing variables analysis was conducted to determine whether or not data were missing completely at random, which determined how missing data were handled (i.e., to determine whether listwise deletion was appropriate). Bivariate correlations also were examined and reported among all variables, including relevant demographic and study variables. Covariates that were significantly associated with both maternal EF and harsh parenting behaviours or with both a stress variable (i.e., household chaos or SES) and harsh parenting were included in the main analysis. Analyses were conducted using SPSS 24.0 and with the PROCESS v3 macro for SPSS (Hayes, 2017; IBM Corp., 2016).

Main analyses.

Multiple regression analyses were utilized to test the first aim. First, a model was constructed predicting harsh parenting behaviours from relevant covariates, stress variables (household chaos and SES), the composite task-based EF skills score, and the interaction between each stress variable with task-based EF skills. Second, a similar model was constructed, except replacing task-based EF skills with self-reported EF difficulties. If the interactions were significant, simple slopes analyses were conducted to compare the association between either household chaos or SES and harsh parenting behaviours at different levels of EF (Mean ± 1 SD). In addition, the main regression analyses were checked for any violations of assumptions (Tabachnik & Fidell, 2013).

Across these analyses, it is important to note that the possible inflation of Type I error was a concern. Corrections, such as Bonferroni corrections, are typically utilized to address this issue, but have been criticized for being overly conservative, increasing Type II error rates, and thus reducing the power of statistical tests (Perneger, 1998). As a result, and based on recommendations from Nakagawa (2004), these corrections were not applied to the current study; instead, statistically significant findings were interpreted along with careful consideration of their corresponding effect sizes (Nakagawa, 2004).

2.2. Results: Aim 1

2.2.1. Data Inspection

The percentage of missing scores ranged between 0% and 2.9% across all measures, including potential covariates. Little's (1988) Missing Completely at Random (MCAR) test supported the assumption that data were missing completely at random and that missingness was not associated with participant characteristics, $\chi^2(21) = 23.97$, $p = .295$. Due to the small number of missing values, and the fact that data were MCAR, listwise deletion was utilized in subsequent analyses to handle missing data.[5]

The means, standard deviations, and ranges for all variables are presented in Table 2. All data distributions were assessed for normality. Valid scores were all in the acceptable range for skewness and kurtosis (|<3| and |<10| respectively). Outliers were identified in one of two ways: (1) for measures with norms available, outliers were identified if they were 3 SDs greater or less than the normative mean, or (2) if normative data was not available, outliers were identified

[5] Although the use of listwise deletion has the caveat of potentially leading to different sample sizes across analyses, this did not occur in the main analyses (i.e., the same individuals had missing data in each of the main regression models).

using the criterion of at least 3.29 SDs greater or less than the mean of the sample (Tabachnik & Fidell, 2013).

Table 2. Descriptive statistics for main study variables (harsh parenting behaviours, stress, and EF variables) and potential covariates.

Measures	**Total (*N* = 104)**		
	***M* (*SD*)**	**Range**	**Possible Range**
DV			
Harsh Parenting Behaviours	2.29 (0.53)	1.00 – 3.50	1-4
Stress Variables			
Household Chaos	29.28 (7.49)	17-51	15-60
SES[a]	50.43 (10.41)	14-66	8-66
EF Variables			
Cognitive Inflexibility[b]	1.59 (1.00)	0.00-7.00	--
Problem Solving[c]	57.26 (8.84)	30-79	20-80
Task-based EF Skills	0.02 (0.85)	-3.79-2.01	--
Self-reported EF Difficulties	100.96 (21.70)	71-184	70-210
Potential Covariates			
Verbal Cognitive Ability[c]	54.27 (9.80)	29-80	20-80
Depression	0.48 (0.63)	0.00-2.67	0-4
Anxiety	0.47 (0.58)	0.00-2.83	0-4
Hostility	0.49 (0.45)	0.00-2.20	0-4
Psychological Symptoms	0.00 (0.86)	-0.89-2.89	--
Child Behaviour Problems	9.62 (6.24)	0-30	0-40

Note. SES = Socio-economic Status, EF = Executive Functions. For the composite variables assessing task-based EF skills and psychological symptoms, their component variables (e.g., cognitive inflexibility, depression, etc.) also are described in this table as this information was deemed more useful and interpretable compared to a standardized and averaged composite score.

[a] SES was assessed by the Hollingshead family SES raw score (Hollingshead, 1975).

[b] The cognitive inflexibility score was assessed as the total number of perseverative errors occurring per switch in sorting principle on the WCST.

[c] The problem solving score and the verbal cognitive ability score were assessed using the Wechsler Abbreviated Scale of Intelligence-II (Wechsler, 2011). T-scores are reported in this table and utilized in analyses.

For the DV of harsh parenting behaviours, normative data were not available. Using the second criterion, there were no outlier scores that were 3.29 SDs greater or less than the mean for the sample. Turning to the composite task-based EF skills variable, there was one outlier score less than 3.29 SDs below the sample mean. On the self-reported EF measure (BRIEF), one

mother was identified as scoring more than 3 SDs above the normative mean. For the indicators of stress, no outliers were identified for household chaos. However, one mother demonstrated a Hollingshead SES score lower than 3.29 SDs below the sample mean.

With regard to covariates, there were no outliers on the vocabulary subtest of the WASI-II (the measure of verbal cognitive ability) when compared to normative data. For overall maternal psychological symptoms, one mother's score was greater than 3.29 SDs above the sample mean.[6] No outliers were identified for child behaviour problems on the SDQ (compared to a normative sample of American children), mother age, or child age.

Upon visual inspection, none of the mothers who were identified as outliers on the variables noted above had scores on other variables that seemed atypical. To further determine whether inclusion of outlier scores would alter findings, I compared the pattern of the bivariate correlations among variables and beta weights in the main regression models when outliers were truncated to 3 or 3.29 SDs above or below the normative or sample means, respectively, with these same statistics when all outliers were non-adjusted. The resulting pattern of findings remained similar, suggesting that the presence of these outliers did not impact findings. Therefore, instead of truncating the outlier scores, I opted to utilize the unadjusted outlier scores in the analyses.

2.2.2. Description of Scores

The mean of mothers' harsh parenting behaviour ratings fell at approximately the midpoint of the scale (2.29 on a scale ranging from 1 to 4). These scores were comparable to scores of non-clinic samples as reported in the Fast Track Project Technical Report for this

[6] The sample mean was used because norms were not available for a composite score composed of the Depression, Anxiety, and Hostility scores.

measure (Miller-Johnson & Maumary-Gremaud, 1995). With regard to household chaos, mothers in this sample reported moderate levels of chaos in their homes, with a mean level similar to that of previous studies (e.g., Atsaba-Poria & Pike, 2008; Coldwell et al., 2006). On average, this sample demonstrated SES in the upper range of the Hollingshead (1975) raw scale. When categorized according to Hollingshead's (1975) five levels of social strata, 34.6% of the sample were in the highest level (level 5; i.e., Major business and professional), 50.5% of mothers were in level 4 (i.e., Medium business, minor professional, technical), 9.9% of mothers were in level 3 (i.e., Skilled craftsmen, clerical, sales workers), 3.0% were in level 2 (i.e., Machine operators, semiskilled workers), and 1.0% were in level 1 (i.e., unskilled laborers, menial service workers).

For the task-based EF measures, normative data available for the WCST is based on scores calculated using a different method than the present study. For the purpose of comparison, when utilizing the same metric as in previous studies and comparing to a normative sample of individuals ranging from 40 to 49 years of age with 13 through 15 years of education, the average percent perseverative error score for mothers in this sample fell at the 66th percentile (Heaton et al., 1993).[7] Similarly, mothers' mean score in the current sample fell at the upper level of the average range (75th percentile) compared with the normative sample on the Matrix Reasoning subtest, which was the measure utilized to assess problem solving skills (Wechsler, 2011). With regard to self-reported EF difficulties, when compared with a normative sample of individuals ranging from 40-49 years of age, the current sample mean fell in the average range of experiencing EF difficulties (68th percentile).

[7] Please note that the average percentile scores for percent perseverative errors may be upwardly biased given issues identified in the Method section regarding the calculation of this score in this sample.

With regard to variables that were examined as potential covariates, mothers' verbal ability fell in the average range (68th percentile; Wechsler, 2011). Mothers' mean level of depression, anxiety, and hostility also were in the average range when compared to a normative adult female nonpatient population (70-75th percentile; Derogatis, 1993). Lastly, the mean level of total behaviour problems in mothers' target children, as measured on the SDQ, was higher than approximately 77% of 8-10-year-old children in a normative American sample (http://www.sdqinfo.org).

Therefore, on average, mothers in the current sample reported harsh parenting and household chaos scores that were comparable to scores reported in previous non-clinic samples. They were largely from higher SES families, and demonstrated average cognitive flexibility skills, as well as problem-solving skills in the upper level of the average range. Furthermore, they reported a relatively higher number of child behaviour problems compared with other non-clinic or normative samples. However, their self-reported EF difficulties, verbal ability, level of depression, anxiety, and hostility were all within the average range.

Next, bivariate associations among the main study variables, as well as with potential covariates were examined (Table 3). Replicating numerous previous findings and supporting the validity of these measures in this sample, mothers' reports of harsh parenting behaviours were significantly associated with more child behaviour problems and greater maternal psychological symptoms (e.g., Lovejoy et al., 2000; Park, Johnston, Colalillo, & Williamson, 2016). Furthermore, previous research has demonstrated significant associations between household chaos and harsh parenting behaviours (e.g., Coldwell et al., 2006), which is replicated in the present study. SES was not associated significantly with any of the study variables except mothers' age and task-based EF skills. These associations indicated that mothers who were of

higher SES were likely to be older and to have stronger EF skills, which replicates findings from previous studies (Deater-Deckard, Chen, Wang, & Bell, 2012a; Deater-Deckard et al., 2012b). In sum, the significant associations that were demonstrated among the parenting and stress variables generally support their validity and their use in the current study.

Table 3. Bivariate correlations among main study variables and with potential covariates.

	1	**2**	**3**	**4**	**5**
Main Study Variables					
Harsh Parenting Behaviours (1)	--	.24*	.19	-.01	.24*
Household Chaos (2)		--	-.01	-.04	.42***
SES[a] (3)			--	.22*	-.13
Task-based EF Skills (4)[b]				--	.04
Self-reported EF Problems (5)	--	--	--	--	--
Potential Covariates					
Verbal Cognitive Ability	-.14	.16	.01	.27**	-.05
Psychological Symptoms[c]	.26**	.43***	-.11	.02	.74***
Child Behaviour Problems	.26**	.30**	-.08	-.10	.31**
Child's Age	.04	-.01	.17	.19*	-.21*
Mother's Age	.06	.19	.23*	.11	-.12

Note. SES = Socio-economic Status, EF = Executive Functions. Degrees of freedom for these correlations ranged from 100 to 103 due to missing data. [a] SES was assessed by the Hollingshead family SES raw score with higher scores indicating higher socio-economic status (Hollingshead, 1975). [b] The task-based EF skills variable was calculated as a composite of the cognitive inflexibility (reversed) and problem-solving scores. [c] The maternal psychological symptoms variable was calculated as a composite variable of symptoms of depression, anxiety, and hostility. * $p < .05$, ** $p < .01$, *** $p < .001$.

The composite task-based EF skills variable was associated with higher SES and stronger verbal cognitive ability, as expected from previous findings (e.g., Azar et al., 2017; Deater-Deckard et al., 2012a) and supporting the validity of this EF variable. Task-based EF skills also were positively related to child age. However, the correlation between the task-based EF variable and the self-report measure of EF problems was not significant. This is somewhat surprising, given that these measures are purported to assess the same construct or at the least, similar constructs. As mentioned in the introduction, relatively recent reviews on this topic suggest that this is not an atypical finding and may be an indication that task-based and self-report measures

are assessing different underlying mental constructs related to executive functions (Toplak et al., 2013). This idea is explored further in the general discussion section.

Despite the lack of significant association with task-based EF skills, self-reported EF difficulties were significantly associated with harsher parenting behaviours (Crandall et al., 2015), household chaos (Mokrova et al., 2010), child behaviour problems (Moroney, Tung, Brammer, Peris, & Lee, 2017), and child age, as demonstrated in previous research and in support of the EF measure's validity. Furthermore, self-reported EF difficulties were strongly associated with greater psychological symptoms, suggesting a large overlap between these two constructs.

2.2.3. Identification of Covariates

Potential covariates were examined and identified in two ways. First, they were identified for inclusion in the main multiple regression analyses if they were correlated with both harsh parenting behaviours (DV) and either an EF variable, household chaos, or SES. However, based on recommendations by Tabachnik and Fidell (2013), potential covariates that were correlated with an EF or stress variable at greater than .70 were not included due to concerns with violating the assumption of non-multicollinearity. Both psychological symptoms and child behaviour problems were significantly correlated with harsh parenting behaviours and household chaos, and were included as covariates for the regression models (See Table 3). At the same time, psychological symptoms were correlated with self-reported EF difficulties at a level greater than .70. Consequently, psychological symptoms were not included as a covariate for regression models that examined self-reported EF difficulties.

Second, I conducted one-way ANOVAs or independent samples *t*-tests to determine whether the main study variables differed depending on the categorical demographic variables of

child gender, marital status, maternal employment status, and maternal ethnicity. None of the main variables differed based on child gender. However, the ANOVA and post-hoc comparisons for marital status indicated that mothers who were in married or common-law relationships were of higher SES compared to mothers who were divorced/separated or single, $F(2,98) = 8.41$, $p < .001$ There were no differences in SES between mothers who were divorced/separated and mothers who were single. In addition, mothers who were employed demonstrated better task-based EF skills compared to mothers who were not employed, $t(100) = 2.10$, $p = .039$. However, none of the other main study variables differed depending on marital status or maternal employment status, and therefore these variables were not utilized as covariates.

There also were differences in harsh parenting behaviours and task-based EF measures based on maternal ethnicity (European/North American, East Asian, and Other), $F(2,101) = 4.18$, $p = .018$ and $F(2,101) = 7.70$, $p = .001$, respectively. Post-hoc analyses indicated that mothers who identified as being from a European/North American background demonstrated less harsh parenting behaviours compared to mothers identifying as being from an East Asian background, however, these two groups did not differ in their performance on the EF tasks. In comparison, mothers from a European/North American background did not differ in harsh parenting levels compared to mothers from all other ethnicities, but they performed better on the EF tasks compared to these same mothers. Given that no two groups differed on both variables (harsh parenting behaviours and task-based EF skills), maternal ethnicity was not examined as a covariate in the main analysis. In sum, none of the categorical demographic variables were identified as covariates to include in subsequent analyses.

2.2.4. Main Analyses

The first aim of this study was to examine the unique associations of harsh parenting behaviours with measures of stress (household chaos and SES), EF (task-based, and self-reported) and the interactions between each stress and EF variable. I hypothesized that each measure of stress would be uniquely associated with harsh parenting behaviours, and that EF would moderate these associations above and beyond their main effects. Linear regression analyses were utilized to test these research questions, resulting in two separate regression models, one using the task-based measure of EF, and the second using the self-report measure of EF.

In Model 1, harsh parenting behaviours were regressed on relevant covariates (psychological symptoms and child behaviour problems), household chaos, SES, task-based EF skills, the interaction between household chaos and task-based EF skills, and the interaction between SES and task-based EF skills. In Model 2, harsh parenting behaviours were regressed on child behaviour problems[8], household chaos, SES, self-reported EF difficulties, and the interactions between household chaos and SES with self-reported EF difficulties. Both regression models met assumptions of independent errors and lack of multicollinearity. Furthermore, visual inspection of the scatterplot of residuals and the normal probability plot indicated that both models likely met assumptions of homoscedasticity, linearity, and normality of residuals. Across these analyses, based on recommendations from Nakagawa (2004), statistically significant findings were carefully interpreted along with consideration of their corresponding effect sizes.

[8] As mentioned previously, maternal psychological symptoms were not included in this analysis due to its high correlation with self-reported EF and concerns with violating the assumption of multi-collinearity.

More specifically with regard to effect sizes, although the beta coefficient is often interpreted as an effect size measure analogous to a correlation coefficient, recent literature suggests that beta coefficients (otherwise known as standardized partial coefficients) are upwardly biased when there is considerable multicollinearity within the regression model (Dudgeon, 2016). Statisticians have argued that a more accurate measure of effect sizes is derived through the calculation of the semi-partial correlation (Disabato, 2016):

$$sr_1 = \beta_1\sqrt{1 - R_1^2}$$

This equation is defined such that sr_1 refers to the semi-partial correlation of predictor 1, $ß_1$ refers to the standardized partial coefficient of predictor 1, and R_1^2 refers to the proportion of variance explained in predictor 1 by all other predictors. The resulting semi-partial correlations can be interpreted using Cohen's (1988) guidelines: small (*sr* = at least .10), medium (*sr* = at least .24), and large (*sr* = at least .37). I utilized this equation to calculate the semi-partial correlations (i.e., effect size) of each significant association in the regression models.

Table 4 presents the model statistics and beta weights for these analyses. For Model 1, the overall model was significant. Contrary to my hypothesis, the main effect of household chaos was not significant, however, household chaos did interact with task-based EF skills to predict harsh parenting ($sr_{chaosXEF}$ = -.22, small effect size). To probe this interaction, I examined the simple slopes of household chaos in relation to harsh parenting at different levels of task-based EF skills (± 1SD; Figure 3). At low levels of EF skills, household chaos was positively associated with harsh parenting behaviours, *ß* = .35, *p* = .022. However, at higher levels of EF skills, household chaos was not significantly associated with harsher parenting behaviours, *ß* = -.11, *p* = .494. This finding supports the hypothesis that EF skills play a buffering role with regard to the significant association between household chaos and harsh parenting behaviours.

Furthermore, there was a significant association between SES and harsh parenting behaviours (sr_{SES} = .20, small effect size), however this association was in an unexpected direction; higher SES was associated with harsher parenting behaviours. There was no EF moderation of the association between SES and parenting.

Table 4. Multiple linear regression equations predicting harsh parenting behaviours (*n* = 100).

	ß	***t***	***p***	R^2	R^2 ***p*-value**
Model 1				.18	.009
Child Behaviour Problems	.12	1.17	.245		
Psychological Symptoms	.15	1.32	.190		
Household Chaos	.12	1.09	.278		
SES	.21	2.13	.036		
Task-based EF skills	-.01	-0.11	.913		
Household Chaos X Task-based EF skills	-.23	-2.07	.041		
SES X Task-based EF skills	.05	0.64	.521		
Model 2				.23	.0004
Child Behaviour Problems	.22	2.20	.030		
Household Chaos	.05	0.49	.629		
SES	.17	1.74	.085		
Self-reported EF difficulties	.20	1.84	.069		
Household Chaos X Self-reported EF difficulties	-.18	-1.84	.069		
SES X Self-reported EF difficulties	.28	2.90	.005		

Note. SES = Socio-economic Status; EF = Executive Functions;

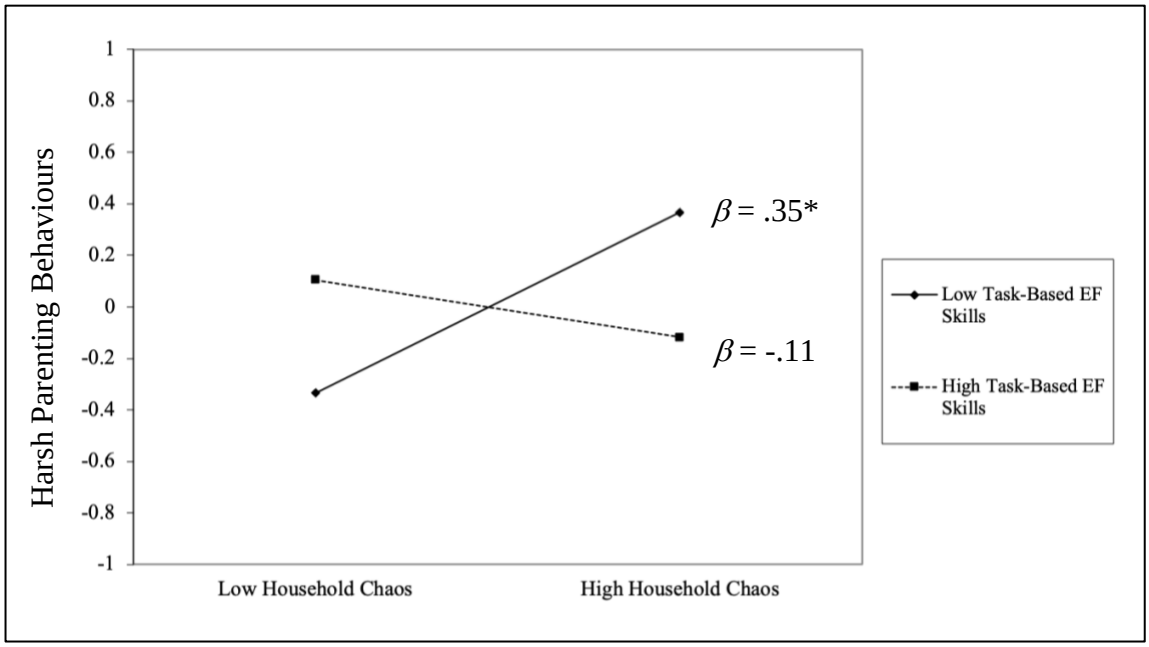

Figure 3. Two-way interaction between household chaos and task-based EF skills.

In Model 2, the overall explained variance was significant. Greater self-reported EF difficulties (lower EF skills) were marginally associated with harsher parenting behaviours (sr_{EF}= .16, small effect size). There also was a marginally significant two-way interaction between self-reported EF difficulties and household chaos ($sr_{EFXChaos}$= .16, small effect size; Figure 4). Simple slopes analysis indicated that at low levels of self-reported EF difficulties (better EF skills), household chaos was marginally associated with harsher parenting behaviours, *ß* = .23, *p* =.078. However, at higher levels of self-reported EF difficulties (lower EF skills), household chaos was not significantly associated with harsh parenting behaviours, *ß* = -.13, *p* =.430. Examination of Figure 4 demonstrates that for individuals with higher levels of self-reported EF difficulties (lower EF skills), parenting appeared to be relatively harsh regardless of level of household chaos. Although this interaction was different from that found in Model 1, it was still consistent with the hypothesis that the level of contextual stress (from household chaos or SES) would interact with levels of EF skills to predict harsh parenting behaviours. Furthermore, in Model 2 similar to Model 1, higher SES was marginally associated with harsher

parenting behaviours (sr_{SES}= .16, small effect size), and the direction of this association was unexpected. However, this marginal main effect was qualified by a significant two-way interaction with self-reported EF difficulties (sr_{EFXSES}= .26, medium effect size; Figure 5). Simple slopes analysis indicated that at low levels of self-reported EF difficulties (better EF skills), the association between SES and harsh parenting behaviours was not significant, ß = -.12, p =.435. However, at high levels of self-reported EF difficulties, higher SES was associated with harsher parenting behaviours, ß = .45, p < .001. Therefore, both in the marginal main effect of SES, and in the association between SES with harsh parenting behaviours in the group of mothers with higher levels of self-reported EF difficulties, the relation between SES and harsh parenting was in an unexpected direction. Finally, greater child behaviour problems were also associated with harsher parenting behaviours ($sr_{Child\ behaviour\ problems}$ = .20, small effect size) in Model 2.

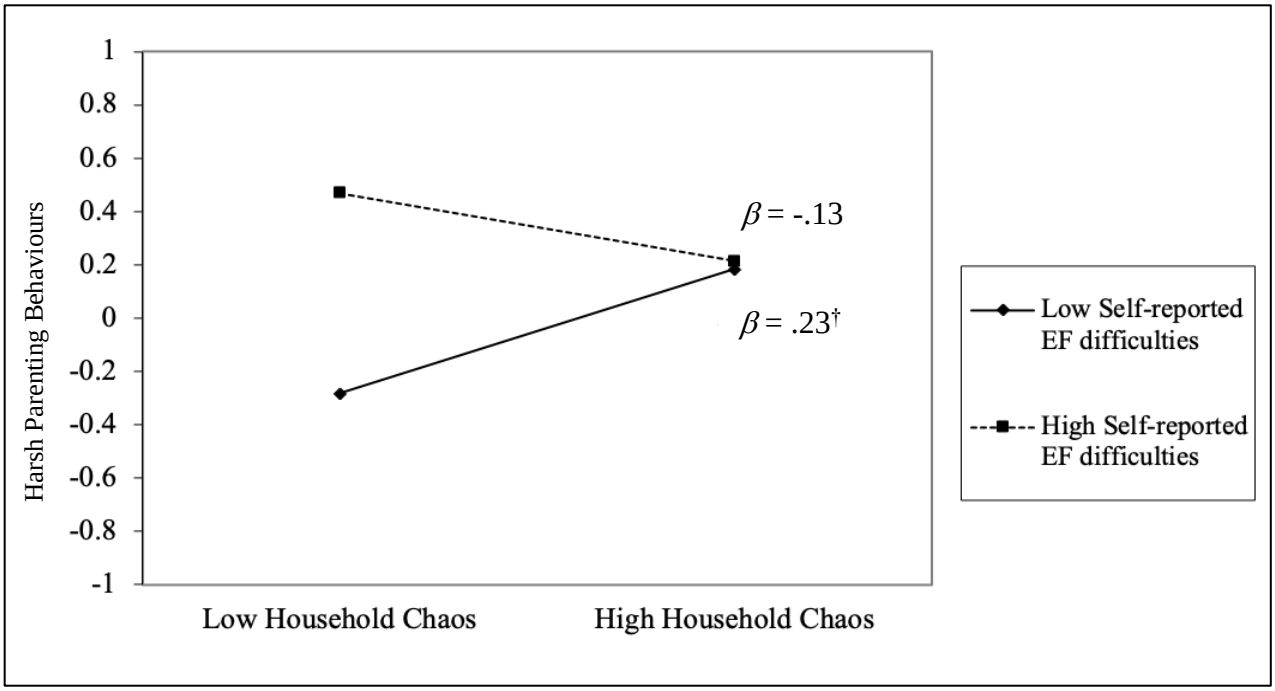

Figure 4. Marginal two-way interaction between household chaos and self-reported EF difficulties.

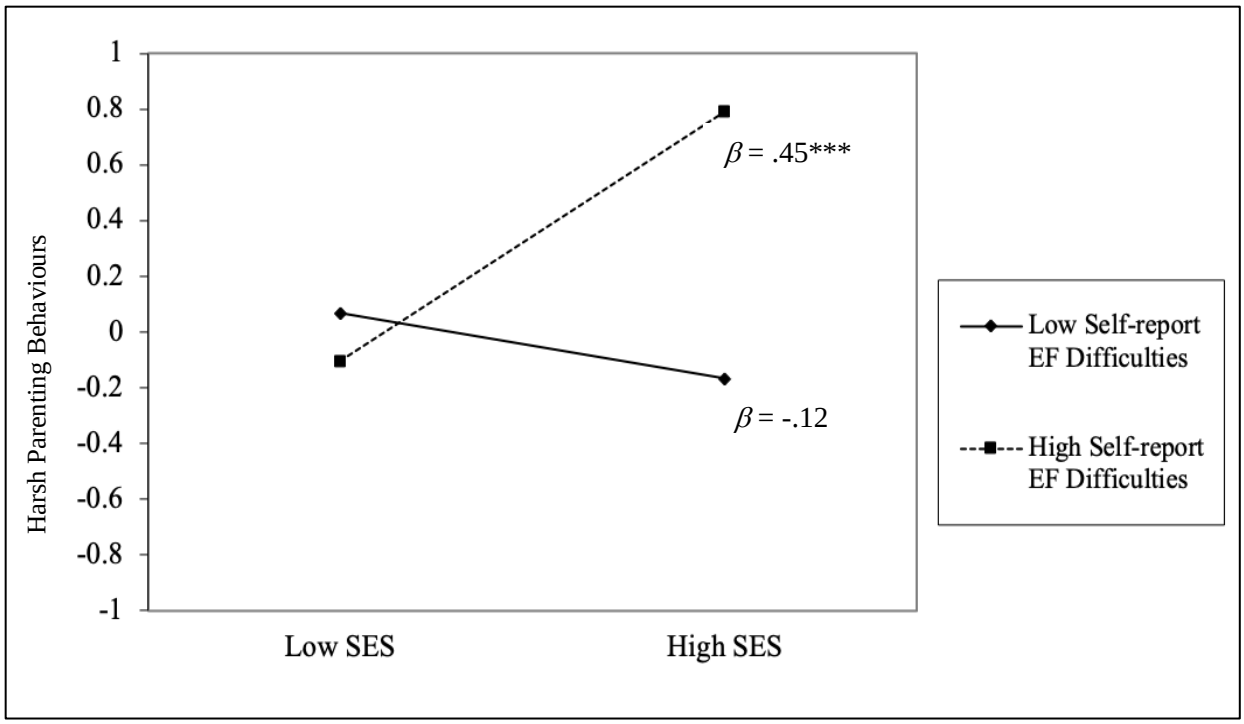

Figure 5. Two-way interaction between SES and self-reported EF difficulties.

2.2.5. Additional Analyses

I ran additional post-hoc analyses to explore these unexpected findings with regard to SES (the direction of the association between SES and harsh parenting in Model 1, the direction of the marginal association between SES and harsh parenting in Model 2, and the significant positive association between SES and harsh parenting for mothers with greater self-reported EF difficulties in Model 2). First, I re-examined the distribution of SES for this sample of mothers. As reported previously, one mother was identified as an outlier (falling below 3.29 SDs of the sample mean, in the lowest range of SES). Examination of the scatterplot depicting the association between SES and harsh parenting behaviours suggested that this association may be spurious due to the single outlier (See Figure 6; the outlier is identified by the arrow). To test this possibility, I excluded this mother and re-ran both regression models to see whether this changed the pattern of findings. More specifically, although, as reported in the section outlining treatment of outliers, truncating this mother's score did not change the overall pattern of findings between

SES and harsh parenting behaviours, in this analysis I removed her score completely to examine whether inclusion of her score was contributing to a spurious association between these variables. Results of these analyses are presented in Table 5

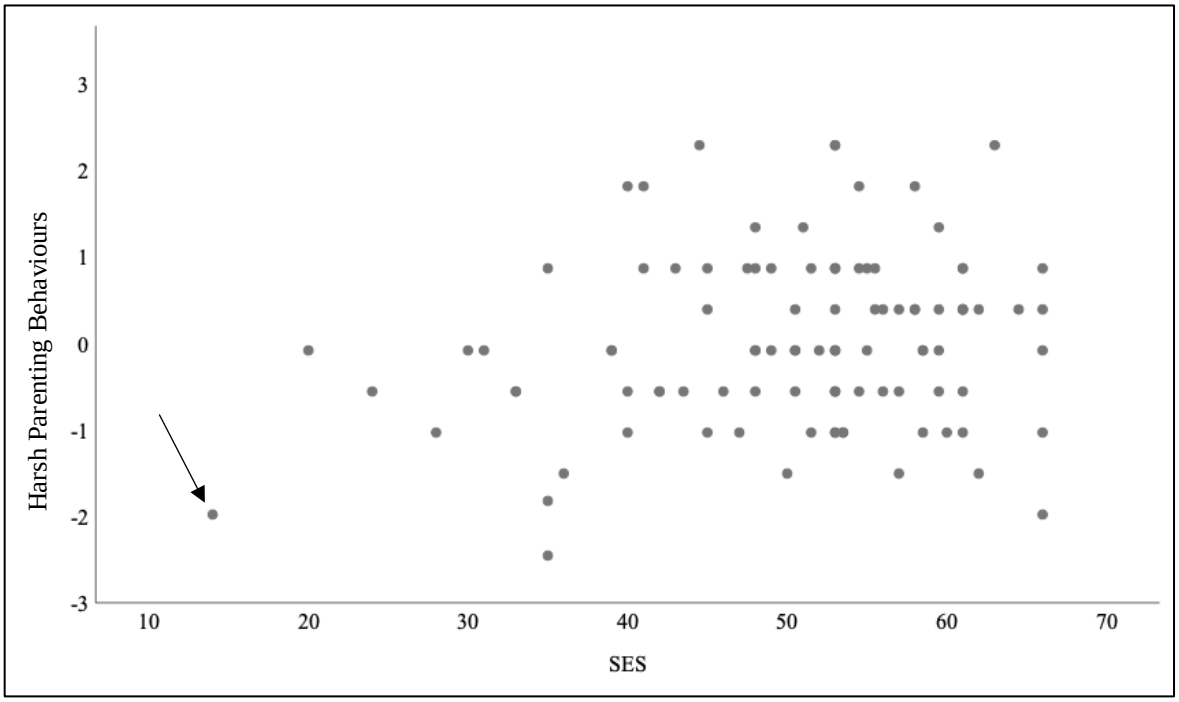

Figure 6. Scatterplot demonstrating the bivariate association between SES and Harsh Parenting Behaviours. The outlying datapoint is identified with an arrow.

Table 5. Multiple linear regression equations predicting harsh parenting behaviours excluding SES outlier (*n* = 99).

	ß	***t***	***p***	R^2	R^2 ***p* value**
Model 1				.19	.006
Child Behaviour Problems	.16	1.48	.142		
Psychological Symptoms	.20	1.75	.084		
Household Chaos	.06	0.53	.596		
SES	.10	0.94	.352		
Task-based EF skills	-.0004	-0.04	.971		
Household Chaos X Task-based EF skills	-.25	-2.27	.026		
SES X Task-based EF skills	-.02	-0.21	.836		

	ß	*t*	*p*	R^2	R^2 *p* value
Model 2				.20	.002
Child Behaviour Problems	.23	2.34	.022		
Household Chaos	.03	0.25	.800		
SES	.13	1.41	.162		
Self-reported EF difficulties	.24	2.15	.035		
Household Chaos X Self-reported EF difficulties	-.20	-1.98	.051		
SES X Self-reported EF difficulties	.20	1.77	.081		

Note. SES = Socio-economic Status; EF = Executive Functions;

In Model 1, re-analysis without the mother who was an outlier on SES demonstrated that there was no longer a significant association between SES and harsh parenting behaviours. Instead, there was a marginally significant association between greater psychological symptoms and harsher parenting behaviours ($sr_{psychological\ symptoms}$ = .18, small effect size). All other associations remained similar to the original Model 1.

In the re-analysis of Model 2, the interaction between SES and self-reported EF difficulties was now only marginally significant (sr_{SESXEF} = .19, small effect size). In addition, the relation between SES and harsh parenting behaviours was no longer significant, while self-reported EF difficulties now significantly predicted harsh parenting behaviours (sr_{EF} = .19, small effect size); both associations were marginally significant in the original Model 2). The pattern of all other associations remained similar to the original Model 2. These results suggest that the undue influence of one outlier on the SES scale accounted for the unexpected findings with SES. Importantly, when this outlier was removed, both the expected significant interaction between task-based EF skills and household chaos and the marginal interaction between self-reported EF skills and household chaos remained.

2.3. Discussion: Aim 1

Parents are tasked with the important role of raising their children, and therefore understanding what factors may be associated with harsh parenting behaviours or interact to

predict harsh parenting behaviours is a critical endeavor. Overall, findings from the first aim of this study indicated that, in line with my hypotheses regarding the direct associations between parenting and stress and EF, both household chaos and self-reported EF difficulties were significantly associated with harsh parenting in their bivariate correlations. Furthermore, self-reported EF difficulties were uniquely associated with harsh parenting behaviours in the regression analysis. However, neither SES nor task-based EF were associated directly with harsh parenting, contrary to my hypotheses. When examining the moderating role of EF, I found that when EF was measured using EF tasks, these EF skills buffered the association between household chaos and harsh parenting behaviours. When EF was measured via a general self-report questionnaire, findings suggested that EF skills marginally moderated parenting only for mothers reporting less chaotic homes. Among mothers who reported more chaotic homes, higher levels of harsh parenting were reported regardless of the level of EF skills. Although the stress-buffering effects of EF were clearest for task-based EF measures, both interaction effects were consistent in implicating that the association between contextual stress (in this case, household chaos) and harsh parenting depends on maternal levels of EF.

2.3.1. Stress and Harsh Parenting

The results for the first aim of this study confirmed the well-established relation between household chaos (as an indicator of stress) and harsh parenting behaviours (e.g., Coldwell et al., 2006; Mills-Koonce et al., 2016; Pike et al., 2016; Zvara et al., 2014), at least at the level of bivariate associations. Mothers who reported more chaotic homes that are disorganized, lacking routine, and noisy, also were more likely to parent their child harshly. As hypothesized by the family stress model (Conger et al., 1992), it is possible that chaotic environments lead to increased emotional arousal, which then overflows to affect parent-child interactions. Although

the examination of mediators such as maternal emotional arousal was beyond the scope of this study, this theory is helpful in conceptualizing how chaos in the home could increase the stress levels of parents and spillover negatively into parenting. Moreover, household chaos may exert a distal influence on child behaviour problems through the demonstrated association with harsh parenting behaviours (e.g., Mills-Koonce et al., 2016). These findings suggest that helpful interventions to support healthy child development and positive parenting skills would provide parents with education and strategies on how to schedule, maintain, and organize their homes and household routines effectively.

At the same time, the limitations of this demonstrated association must be acknowledged. First, household chaos was no longer significantly associated with harsh parenting behaviours once other variables were controlled in the larger regression equation, implying that this association may be accounted for by other factors. In addition, both household chaos and harsh parenting were measured through self-report, which introduces the possibility of biased response patterns that could inflate the size of association. Although previous studies have found significant associations even when using observer-rated household chaos and observed harsh parenting behaviours (e.g., Mills-Koonce et al., 2016), all of these studies were correlational in nature. It is assumed that stress is the underlying mechanism by which household chaos affects parenting, however, this cannot be confirmed through the findings from current studies including the findings from Aim 1. For example, these studies do not rule out method effects or other external factors that could be accounting for the association. While correlational results lend support to the hypothesis that stress affects parenting, stronger experimental designs are needed to fully test this hypothesis.

In contrast to the results for household chaos, I did not find the expected bivariate association between SES, the second measure of stress, and harsh parenting behaviours. In fact, the multiple regression results indicated a relation in the direction opposite to prediction. However, follow-up analyses indicated with one mother's outlying score removed, the association between SES and harsh parenting behaviours within the regression analysis was no longer significant. It is possible that the lack of association could be due to the relatively high SES level of the sample. Previous studies that have demonstrated relations between SES and harsh parenting behaviours have typically looked at population level data covering the full range of SES (e.g., Eckenrode et al., 2014) or have selectively recruited parents from lower income neighbourhoods or schools (e.g., Dodge et al., 1994). Perhaps most comparable to the current sample in both range and mean level of SES as well as median incomes (taking into account both rates of inflation and the currency exchange rate) was the sample of mothers utilized in Sturge-Apple et al.'s (2014) study, who, similar to the current study, were recruited from local assistance offices and flyers in the community. However, Sturge-Apple et al.'s study demonstrated the expected associations between low SES and harsh parenting behaviours and the current findings did not. Although my sample included mothers with diverse SES scores, less than 15% of mothers were in the lowest three of five SES levels on the Hollingshead scale whereas Sturge-Apple et al.'s sample included a larger proportion of families receiving public assistance (35%). Therefore, the composition of this sample did not adequately capture a representative proportion of mothers living in low SES contexts, and this restriction of SES range may have precluded the expected significant association between SES and harsh parenting behaviours.

Furthermore, although the Hollingshead's (1975) measure of SES is well utilized within even the most recent literature (e.g., Jones, Putt, Rabinovitch, Hubbard, & Snipes, 2017; Perry, Dollar, Calkins, Keane, & Shanahan, 2018), it is an older assessment tool that may no longer accurately capture SES. For instance, among the categories used to classify individuals' occupations, many are not relevant in the current workforce and the categories do not take into account more modern occupations (e.g., software development managers, architectural technologists). In addition, many of the previously mentioned studies that have found relations between SES and harsh parenting behaviours were conducted with parents living in the United States (e.g., Dodge et al., 1994; Sturge-Apple et al., 2014). The differences between the American and Canadian health and social systems as well as differences in violent crime rates suggest that low SES, when used as a measure of stress, may be experienced differently in Canada compared to the United States. That is, all Canadians have access to social and health services, and Canadians experience a lower rate of violent crime compared to Americans (Grinshteyn & Hemenway, 2016). Therefore, the distribution and range of SES in the current sample, as well as the limitations of SES, both in how it was measured and as a measure of stress within the context of Canada, may have precluded the expected association between SES and harsh parenting behaviours. Household chaos may have been a stronger indicator of stress given the nature and social contexts of this sample, as well as the limitations surrounding the SES measure. In addition, the construct of household chaos is more circumscribed than SES, describing actual stressors within the home (e.g., disorder, noise), and its proximity to parenting may contribute further to its strength as an indicator of stress.

2.3.2. The Role of EF

Because I examined the same measures of EF across both Aim 1 and Aim 2 of the current study, I provide only a brief discussion here. A more in-depth discussion summarizing across Aim 1 and Aim 2 is presented in the general discussion section.

I first direct attention to the bivariate associations between EF and harsh parenting behaviours. Based on both theory and research, I predicted that, on average, mothers with stronger EF skills would parent less harshly compared to mothers with weaker EF skills. This hypothesis was partially confirmed based on the significant bivariate associations between self-reported EF difficulties and harsh parenting behaviours. When mothers self-reported that they had difficulty with behaviours such as inhibiting impulses, shifting from task to task, or monitoring their own behaviours, they also reported that they engaged in harsher parenting behaviours. As described in Crandall et al.'s (2015) model, this association makes sense in light of the fact that parenting inevitably involves challenging situations in which, to parent skillfully, mothers are required to redirect their attention and monitor their own behaviours in response to their child's behaviour. However, given that both the EF and parenting variables were assessed using self-report, shared-method variance might again have accounted for this significant association. When the task-based measure of EF was utilized, the correlation with harsh parenting was not significant. Therefore, conclusions regarding the association between maternal EF and harsh parenting behaviours should be made with caution.

In addition to the differences in findings between self-reported and task-based EF in their direct associations with harsh parenting behaviours, there also were inconsistencies in the pattern of interaction between self-reported and task-based EF with household chaos as predictors of harsh parenting behaviours. Consistent with my hypothesis, Crandall et al.'s (2015) model, and

with the findings by Sturge-Apple et al. (2014) and Monn et al. (2017), task-based EF skills buffered the association between household chaos and harsh parenting behaviours. This is especially interesting because these studies utilized diverse samples (e.g., community samples, or a sample experiencing homelessness), different measures of stress (SES, perceived life stress, and household chaos), and different task-based measures of EF (working memory, planning ability, and the task-based measures used in this study). It appears that despite these differences, the stress-buffering effect of maternal performance on EF tasks is robust.

In contrast, and in line with the pattern of findings from Deater-Deckard et al. (2012b), self-reported EF difficulties were marginally associated with harsh parenting in homes where mothers reported lower chaos, and not in homes with higher chaos. However, a direct comparison of the current findings with those of Deater-Deckard et al. is difficult given that different EF measures and composites were used. Furthermore, it is important to interpret this interaction between self-reported EF and household chaos with caution in light of its small effect size and the fact that it was only marginally significant.

It is possible that the differences in the associations and interactions found for task-based EF and self-reported EF reflect that these EF measures are assessing distinct constructs, a suggestion proposed by Toplak and colleagues (2013). As demonstrated in the current findings, Toplak et al. reported a lack of relation between task-based and self-reported EF measures across the literature and posited that these measures may be capturing different underlying mental constructs. The role of both task-based and self-reported EF is deliberated further in the general discussion section. Ultimately, although my results highlight that EFs play a role in interacting with stress in relation to parenting, it also is clear that the construct validity of each EF measure must be considered in interpreting these interaction effects.

2.3.3. Conclusions from Aim 1

The goal of this study's first aim was to replicate and clarify previous inconsistent findings regarding the moderating role of maternal EF on the association between stress (as measured by household chaos and SES) and harsh parenting behaviours. With regard to predictions about direct associations, only my hypotheses regarding the associations between household chaos and harsh parenting behaviours, and between self-reported EF and harsh parenting behaviours were confirmed. SES did not appear to be a relevant correlate of parenting within the current sample, perhaps due to limitations in the variability of SES, or differences in the experience of lower SES within the context of Canada compared to the United States. The hypothesis that task-based EF would buffer the association between household chaos and harsh parenting behaviours was supported, replicating two previous studies (Monn et al., 2017; Sturge-Apple et al., 2014). This suggests that strength in task-based EF may be helpful in mitigating harsh parenting behaviours when parents are experiencing high levels of contextual stress. However, these findings are limited by the correlational nature of the study, and therefore an experimental manipulation of stress is needed to more directly test the question of whether or not stress affects parenting, and whether EF moderates this effect.

3. Aim 2

While Aim 1 sought to replicate findings from previous research examining SES and household chaos as indicators of stress, the goal of Aim 2 of the current study was to extend the literature by addressing limitations and gaps from previous research. As mentioned in the previous aim, one main limitation of the existing research is that stress is not assessed directly, and that the association between stress and parenting is only investigated in correlational research designs. I addressed this limitation by using a stronger, experimental design. Specifically, I manipulated stress by randomly assigning mothers to either a stress group (using the TSST protocol) or a control group (using a placebo protocol) and examined the resulting effect of stress on mothers' parenting. I also extended findings from previous research and from Aim 1 by examining the interaction of EF and manipulated stress on parenting.

Second, I extended the literature by examining both mothers' child-blaming attributions and harsh parenting behaviours as measures of parenting in their relations with experimentally manipulated stress and maternal EF skills. Although previous research has focused mainly on harsh parenting behaviours, cognitions such as child-blaming attributions have been identified as important precursors to parenting behaviours (e.g., Nix et al., 1999, Smith Slep & O'Leary, 1998). Furthermore, social information processing and dual-process models of cognition outline how stress and EF may impact attributions (Andersen et al., 2007; Milner, 1993; Johnston et al., 2018). Stress may decrease maternal ability to engage in more effortful cognitive processing, making mothers more prone to relying on more automatic attributions and behaviours in response to difficult child behaviours, while EF abilities might enhance maternal ability to consider mitigating factors and inhibit less adaptive parenting attributions and behaviours.

In the current aim, I examined both stress and EF in their unique impact and association with maternal child-blaming attributions and harsh parenting behaviours. The research questions for Aim 2 were as follows:

1) Does experimentally-manipulated stress uniquely affect mothers' child-blaming attributions and harsh parenting behaviours?

   I hypothesized that mothers in the stress group would demonstrate more negative child-blaming attributions and harsher parenting behaviours compared to mothers in the control group.

2) Are maternal EF abilities uniquely associated with child-blaming attributions and harsh parenting behaviours?

   I hypothesized that stronger task-based EF skills and less self-reported EF difficulties would be associated with less negative child-blaming attributions and less harsh parenting behaviours.

3) Is the interaction between experimentally-manipulated stress and maternal EF significantly associated with child-blaming attributions and harsh parenting behaviours?

   Similar to the first aim, I hypothesized that mothers' task-based EF skills would buffer the association between experimentally-manipulated stress and harsh parenting behaviour. I also hypothesized that mothers' self-reported EF difficulties would exacerbate associations between experimentally-manipulated stress and harsh parenting behaviour. Although I recognize that the interaction effects were inconsistent between task-based and self-reported EF in the first aim, I continued to hypothesize that both task-based EF and self-reported EF would function in the same direction in the second aim due to the marginal and small effect size of the self-reported EF and household chaos

interaction in Aim 1. Similarly, I hypothesized that mothers' task-based EF skills would buffer the association between experimentally-manipulated stress and child-blaming attributions. I also hypothesized that mothers' self-reported EF difficulties would exacerbate associations between experimentally-manipulated stress and child-blaming attributions.

Potential Covariates/Confounds

The same potential covariates and confounds were examined in analysis for the second aim as were examined in the first aim. In addition, one prominent advantage of random assignment within an experimental design is that it addresses issues of confounding variables, given the assumption that the groups are equivalent except for the experimental manipulation. Therefore, the likelihood of confounds in testing the effects of stress on child-blaming attributions and harsh parenting behaviours within the second aim is reduced. However, to ensure that randomization resulted in the stress group and control group being equivalent on potential confounds, I compared the two groups across demographic variables and the identified potential covariates/confounds.

3.1. Method: Aim 2

3.1.1. Participants

The mothers examined for this aim were identical to those reported for Aim 1. The power calculations described in Aim 1 that were conducted prior to data collection indicated that the sample size of 100 mothers also would be adequate to test the research questions from Aim 2. Specifically, this sample size was attained by predicting a small-to-medium effect size based on previous research examining effects of stress on similar constructs (e.g., Bendahan et al., 2016, Starcke & Brand, 2016), using an alpha level of .05, power of .80, and six predictors.

3.1.2. Measures

To address the second aim, I utilized a portion of the same measures that were examined in the first aim. As such, the task-based EF skills (cognitive inflexibility and problem solving), self-reported EF difficulties, verbal cognitive ability, psychological symptoms, and child behaviour problems are not described in the following section. The reader may refer to the Measures section of Aim 1 for an overview of these variables.

Stress Visual Analogue Scale (SVAS; Manipulation Check Variable).

During the study, mothers filled out the SVAS, which is a simple and validated measure to assess perceived stress (Lesage, Berjot, & Deschamps, 2012). It involves a single question asking mothers to indicate how stressed they feel on a 15 cm line, with endpoints labelled *None* and *As bad as it could be.* SVAS scores were measured as the distance from the *None* endpoint in centimeters. Previous research has demonstrated that the SVAS is associated with other well-validated measures of stress, such as the Cohen's Perceived Stress Scale, and demonstrates good discriminant validity (Lesage et al., 2012). Compared to other, longer, measures of stress, the SVAS was chosen for this study due to its simplicity and ease of administration. Furthermore, the continuous nature of the SVAS may make it more sensitive to subtle effects compared to Likert scales (Allen, Kennedy, Cryan, Dinan, & Clarke, 2014). Previous research using the TSST protocol has used similar visual analogue scales as manipulation checks for perceived stress (Bendahan et al., 2016).

Dependent variables (DVs).

Child-blaming Attributions. Maternal child-blaming attributions were assessed using nine vignettes of common child misbehaviours that were ambiguous with respect to the cause. These vignettes were drawn from previous studies (e.g., Johnston et al., 2017; Johnston, Chen, & Ohan,

2006) and depicted common child misbehaviours. For this study, 18 vignettes were piloted with a group of graduate students and individuals familiar with children (n = 20) and nine vignettes were chosen based on ratings that indicated they best depicted common misbehaviours that were appropriate for 6-10-year-old boys and girls.

Mothers were administered three randomly chosen vignettes from the set of nine vignettes at each of the three time points of the study (T1, T2, and T3). Mothers read each vignette and imagined themselves and their child in the situation. They were told to imagine each situation was happening on a new day, independent of other child behaviours. For example:

> You and your child are sitting at the table eating dinner and talking. Your child reaches in front of you to get more food, and almost knocks over your full water glass. You tell him/her to be careful. He/she reaches out again for some juice and this time knocks your glass over, spilling water all over your plate.

After reading each vignette, mothers rated the cause of the child's misbehaviour on dimensions of causal locus ("My child's behaviour was due to something about him/her"), stability ("My child will behave like this in the future"), globality ("This behaviour of my child affects other areas of our relationship"), intent ("My child behaved like this intentionally"), blame ("My child is to blame for this behaviour"), and responsibility ("My child is completely responsible for this behaviour"). Ratings were made on a 10-point scale (1 = *strongly disagree* to 10 = *strongly agree*). As in previous research (e.g., Park et al., 2016), scores across all nine vignettes and six attributional dimensions were averaged to create a composite score for attributions for child misbehaviours, with higher scores indicating more child-blaming attributions. Previous research has established the validity of these vignettes and attribution ratings by demonstrating significant correlations with observed parenting behaviour and child

behaviour problems (Johnston et al., 2009) and showing that child-blaming attributions produced through these vignettes are relatively congruent with attributions that mothers reported in response to open-ended questions (Johnston, Reynolds, Freeman, & Geller, 1998). As further support for the validity of these attribution ratings, Johnston et al. (2009) found that the attributions of parents of children with ADHD differed compared to those of parents of typically developing children. Previous studies have demonstrated adequate internal consistency (.76 to .78, across nine vignettes depicting negative child behaviours and six dimensions; Johnston et al., 2017) and test-retest reliability (Johnston et al., 2009) for the composite score of these attribution ratings. In the current study, the internal consistency for this measure was adequate (Cronbach's $\alpha = .76$).

Harsh Parenting Behaviour. Following each child misbehaviour vignette, mothers also completed five items about how they would respond to their child's misbehaviour. These items were drawn from the Overreactivity subscale of the Parenting Scale (Arnold et al., 1993). Mothers were asked to choose how to respond to each vignette by rating their intent to use each of five different harsh discipline strategies on a scale from 1 to 7. Each strategy is anchored with descriptors that range from the absence of harsh parenting (i.e., I won't be picky…) to a harsh discipline strategy (i.e.. I will get into a long argument…). Strategies were chosen based on previous psychometric analysis (Lorber, Xu, Slep, Bulling, & O'Leary, 2014), and include "Get into a long argument", "Raise voice/yell", "Do things I don't mean to", "Get frustrated/angry", and "Insult, say mean things". Maternal responses on these items were averaged to create a total score for harsh parenting behaviours. This score has demonstrated adequate internal consistency, test-retest reliability, and concurrent validity (Lorber et al., 2014). In the current study, the internal consistency of this composite harsh parenting scale was excellent, Cronbach's $\alpha = .97$.

3.1.3. Procedure

After completing the three procedural blocks described in Aim 1, mothers were randomized into either a stress group or a control group. Those in the stress group completed the Trier Social Stress Task (TSST) protocol described below. Those in the control group were given similar instructions, but without evaluative and performance components (described below as the Control protocol). Before being provided with instructions for either of the protocols, mothers rated their baseline stress levels (T0) on the SVAS. After they were given instructions, mothers recorded their stress levels again (T1) and were provided with three child behaviour vignettes to read and responded by rating their child-blaming attributions and harsh parenting behaviours. After this, they participated in the first part of the stress/control task, then recorded their stress levels (T2) and were given another three vignettes and rated their child-blaming attributions and harsh parenting behaviours. Next, they completed the second part of the stress/control task, recorded their stress levels (T3), and again rated their child-blaming attributions and harsh parenting behaviours for the final three vignettes of child behaviour. Lastly, mothers received a debrief about the TSST (for those in the stress group) and about the overall study (i.e., to explain the purpose of the study, and to reassure them that their performance on the task was not actually recorded and evaluated). They were given an opportunity to ask any questions regarding the study and were provided with a list of parenting resources. As described in Aim 1, they were provided with a $50 honorarium for their participation.

TSST protocol.

The TSST is a well-validated research paradigm that utilizes social-evaluative demands to reliably induce a stress response in an individual (Allen et al., 2017). Of all available laboratory-based psychological stress procedures, the TSST most closely incorporates key

elements that produce the greatest stress response: social-evaluative threat and uncontrollability (Dickerson & Kemeny, 2004). The TSST has been demonstrated in a multitude of studies to reliably induce a stress response (increased biological markers of stress such as salivary cortisol and adrenocorticotrophic hormone) in 70-80% of study participants (Dickerson & Kemeny, 2004; Kudielka, Hellhammer, & Kirschbaum, 2007) and demonstrates good ecological validity. For instance, one recent study demonstrated that the TSST stress response was strongly correlated with a stress response to an oral exam (Henze et al., 2017).

Although many variations of the TSST have been developed, I followed the classic protocol (Birkett, 2011) with a few adjustments (a shorter duration of the preparation and speech phases) that were supported by meta-analytic evidence as having no effect on overall stress outcomes (Goodman et al., 2017). In this protocol, each mother was first introduced to the task by a research assistant:

> Please imagine that you have applied for a job and have been invited for an interview. You are to convince the panel in five minutes why you think that you would be the best candidate for this position. Please note that you will be recorded by a camera for subsequent voice and behavioural analysis. The members of the panel have completed extensive training in behavioural analysis that allows them to carefully evaluate and analyze your communication skills. You have three minutes to prepare.

Following the preparation time and administration of the T1 SVAS and child behaviour vignettes, mothers were individually taken to an interview room and stood before two trained panelists and a video camera. One of the panelists (i.e., the "chairperson") provided them with the instructions, "Please step up to the line and begin the talk that you have prepared." After this instruction was given, the video camera was switched on. If mothers stopped talking and did not

resume for 20 seconds, they were prompted by the chairperson to continue speaking, “You still have time, please continue.” If mothers were unable to continue speaking, then the chairperson asked follow-up questions from a pre-determined list, such as “What kind of leadership qualities do you have?” or “Why do you think you are especially well-qualified for this task?”.

After 5 minutes, mothers were asked to sit at a table in the corner of the room and fill out the SVAS and ratings for three child behaviour vignettes. Once mothers completed these, they again were asked to stand in front of the panel and were asked to complete an unexpected 5-minute mental arithmetic task:

> We want you to complete a mental arithmetic task. Please count aloud backwards from 2,023 in increments of 17. Please calculate as quickly and correctly as possible. If you miscalculate, we will point out your mistake and you have to start over again.

If a mistake was made, mothers were prompted with, “That was incorrect, begin at 2,023.” Periodically throughout the task, particularly if mothers did not make any errors after several consecutive responses, they were prompted with additional instructions such as, “Please try to calculate faster”, “Please make eye contact”, or “Please put your hands by your side”. Following this task, they were again instructed to sit at the side table and complete the SVAS and ratings for the final three child behaviour vignettes.

Panelists. Eleven panelists were trained to administer this protocol and to use only neutral verbal and non-verbal communication with mothers. These forms of communication demonstrate larger effect sizes of stress response compared to more negative feedback (Goodman et al., 2017). Two panelists were assigned to each mother depending on the panelists’ scheduling availability and each pair included at least one male due to evidence that stress effect sizes are smaller with an all-female panel (Goodman et al., 2017). All panelists were either

undergraduate or graduate level research assistants who underwent training sessions and protocol rehearsals until they mastered protocol administration.

There were two video cameras in the interview room: the first was utilized as a prop (i.e., it was not actually recording) and was directed towards the mother, the second was placed unobtrusively behind the mother and directed at the panelists. The purpose of this second video camera was to record the panelists to allow for coding of panelist behaviour as an adherence check to the TSST protocol. A coding system was developed to monitor how closely panelists followed the protocol script and adherence was examined as a potential control variable in analysis (See Manipulation Check section below for more details).

Control protocol.

A validated placebo version of the TSST was utilized for the control group (Het, Rohleder, Schoofs, Kirschbaum, & Wolf, 2009). In this control version of the TSST, mothers experienced similar physical (sitting and standing for the same duration) and mental demands (having to prepare a speech, but on a non-self-relevant topic), but not the social-evaluative and the uncontrollability components of the TSST. Research assistants gave the instructions below to mothers in the control group, and mothers were given the same length of time as in the TSST (3 minutes) to prepare a speech about a movie, novel, or recent holiday trip.

> In the first portion of the study; you are to prepare a 5-minute talk about a movie, novel, or recent holiday trip that you might share with a friend. Afterwards, we will ask you to practice your talk in an empty room. You will not be videotaped, recorded, or watched. Following this, I will ask you to do a simple math task, which will also not be watched by anybody. You have 3 minutes to prepare and your time begins now.

After filling out the SVAS and ratings for the first three child behaviour vignettes, mothers were each taken to an empty room without panelists or a video camera and were asked to talk aloud for 5 minutes about their chosen topic, "Please step up to the line. Your time to talk about your chosen topic begins as soon as I leave the room." After 5 minutes, the research assistant re-entered the room and asked mothers to fill out the SVAS and child behaviour vignette ratings at a side table. The research assistant then gave mothers the next instructions and again left mothers alone in the room, "During this final 5-minutes of this task, you are asked to sequentially add the number 15, beginning from 0. Please say your answers aloud. Again, you will not be videotaped or observed. Your time begins now". Following this task, mothers were again instructed to complete the SVAS and ratings for the final three child behaviour vignettes.

Manipulation check.

As noted previously, the TSST reliably induces a significant increase in stress levels, both biologically as well as psychologically (Allen et al., 2017; Goodman et al., 2017). The control version of the TSST has been demonstrated to be an effective control protocol due to the absence of a stress response in participants (Het et al., 2009). Therefore, these previous studies support the effectiveness of this stress manipulation. In the current study, I utilized four different strategies to further ensure the effectiveness of the stress manipulation. First, after extensive training of panelists, I piloted the stress task with volunteers (graduate students and acquaintances) who provided feedback that they found the task stressful and appropriately difficult.

Second, I continually monitored the effectiveness of the manipulation for each mother as the study was being conducted. In the stress group, mothers were considered responders if they experienced at least a 3-point increase of perceived stress above their baseline level (T0) on

either T1, T2, or T3 SVAS scores. The 3-point cut-off was chosen based on research that has demonstrated this magnitude of difference pre-to-post TSST, while also demonstrating significant effects of the stress manipulation on a psychological concept (e.g., risk aversion; Bendahan et al., 2016). As mothers participated, I monitored the number of responders relative to non-responders (mothers whose SVAS levels did not increase above 3 points). Although some variability in mothers' perceived stress is to be expected in response to the TSST, I examined the proportion of mothers who were considered non-responders for any indication of whether the task should be adjusted to increase stress levels. According to previous research, approximately 70-80% of study participants should experience a significant biological response to the TSST. Although I did not examine the biological response in my study, I applied this criterion to mothers' reports of perceived stress to determine whether or not the stress task was successful. After 12 mothers had participated, it was noted that only 8 (66.6%) were responders. At this point, I switched the order of the speech and arithmetic tasks in an effort to increase the number of responders. It was hypothesized that surprising mothers with the arithmetic task as well as increasing the time between their preparation for the speech and the actual speech would cause a stronger psychological stress response. Overall, this change appeared to be successful as 85.4% of mothers were considered responders after the order of the speech and math task was switched.[9]

Third, at a group level, to check whether the stress manipulation was effective, a 2 x 4 mixed factorial analysis of variance was utilized to examine the interaction effect between group

[9] Independent samples *t*-tests were conducted between mothers who completed the speech task first and mothers who completed the arithmetic task first to examine whether there were any differences in levels of perceived stress, child-blaming attributions, or harsh parenting behaviours. Because there were no differences across groups on any of these measures, *p*s from .211 to .995, the groups were analyzed together.

(stress vs. control group) and time (T0, T1, T2, T3) on SVAS scores. Table 6 presents the average SVAS scores for each group and across time points. This analysis revealed a main effect of group, $F(1,102) = 24.97$, $p < .001$, $\eta^2 = .197$, indicating that the stress group reported greater perceived stress compared to the control group. Furthermore, there was a main effect of time, $F(2.45, 249.97) = 30.31$, $p < .001$, $\eta^2 = .229$, indicating that there was a significant difference in perceived stress levels between time points. Specifically, pairwise comparisons demonstrated significant differences between T0 and the other time points, mean difference = -2.35 to -2.98, $p < .001$, however T1, T2, and T3 did not differ from each other. Lastly, there was a significant interaction between group and time, $F(2.45, 249.97) = 21.14$, $p < .001$, $\eta^2 = .172$, which indicated that, although there was no difference between groups at T0, the stress group reported greater levels of perceived stress at T1, T2, and T3 compared to the control group (Figure 7). Together, these analyses suggested that the stress manipulation was effective at a mean level.

Table 6. Means, standard deviations, and ranges for perceived stress (SVAS) as a manipulation check for the stress group and the control group.

	Stress (*n* = 53)		**Control (*n* = 51)**	
	M (SD)	**Range**	***M (SD)***	**Range**
T0 SVAS	2.86 (3.06)	0-10.3	2.42 (2.89)	0-10.2
T1 SVAS	6.10 (4.38)	0-15	3.87 (3.46)	0-11.3
T2 SVAS	8.39 (4.72)	0.6-15	2.85 (3.23)	0-14.5
T3 SVAS	7.05 (4.56)	0-14.7	3.04 (3.25)	0-14.5
Overall SVAS (T1, T2 and T3 Average)	7.18 (3.92)	0.6-14.1	3.25 (3.02)	0-13.4

Note. Stress levels from the SVAS were measured on a 15 cm line. Therefore, the possible range of stress rated on the SVAS is from 0 to 15. T0 = Baseline; T1 = After the instructions were presented for either stress or control task; T2 = After the first stress/control task is completed; T3 = After the second stress/control task is completed; SVAS = Stress Visual Analogue Scale

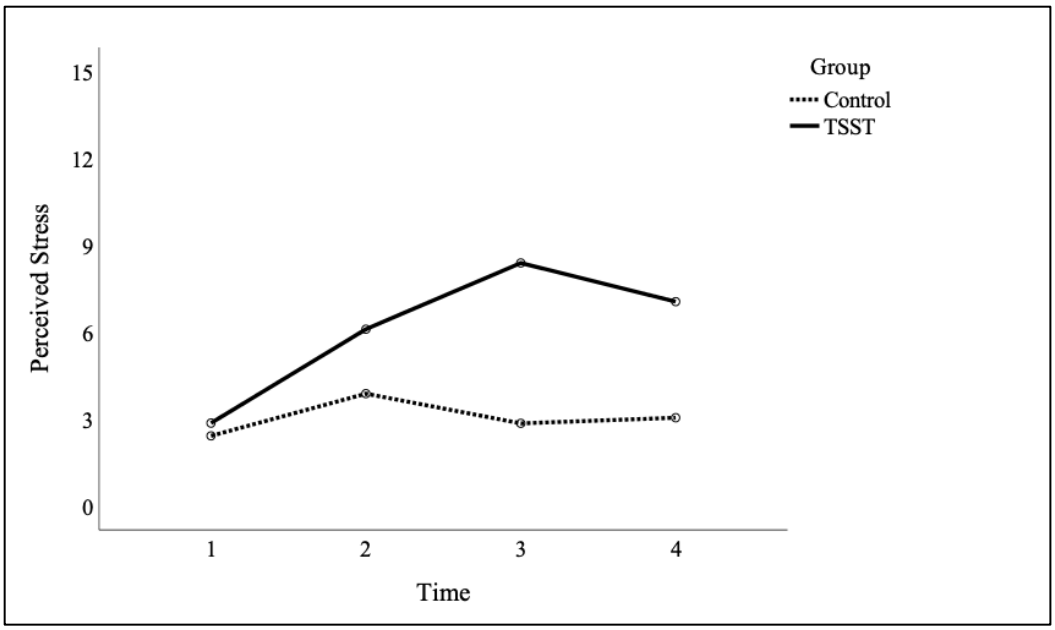

Figure 7. Perceived stress levels reported by the control group and the stress group at different time points. Perceived stress was measured on a scale from 0 to 15.

Lastly, as already noted, panelist behaviour was recorded during the TSST sessions and a coding system was used to determine the degree to which panelists adhered to the TSST procedure (See Appendix 1 for the coding manual). The behaviours coded were based on the classic TSST protocol as described in Birkett (2011). Independent coders watched the recorded videos of the TSST and coded panelist behaviours. Forty-four percent of the videos were independently coded by at least two coders who were blind to which videos were double-coded. Inter-rater reliability across the coded variables was excellent (ICCs ranged from 0.99-1.00).

Coded adherence variables. The number of males on the panel and the gender of the chairperson was recorded for each mother. In addition, for the speech and arithmetic tasks, the duration of time at least one panelist was making eye contact with mothers, total duration of the task, number of added comments that were permissible in the TSST protocol (i.e., scripted comments in the arithmetic task), number of negatively toned off-script comments, number of positively toned off-script comments, number of negative non-verbal behaviours, and number of

positive non-verbal behaviours were coded. For the speech task, the duration of time before the panelists asked questions, and the different questions that were asked also were tracked. For both the speech and arithmetic tasks, the proportion of time where eye-contact was made by at least one panelist was calculated by dividing eye-contact by total time for that task. In addition, a composite negative and positive interaction score was created by summing the negative off-script comments and negative non-verbal behaviours and summing the positive off-script comments and positive non-verbal behaviours, respectively, and for each speech and arithmetic task.

Table 7 presents the descriptive statistics of the coded panelist behaviours. Behaviours that were considered adherent to the TSST protocol included maximizing the proportion of eye contact, a smaller number of unscripted interactions, and a larger number of optional scripted comments within the arithmetic task (e.g., “Please keep your hands by your sides” or “Please look at us.”). Other variables, such as the time before asking questions and the number of questions asked for the speech task, also were tracked to explore whether or not they were associated with stress levels or dependent variables. Overall, the mean proportion of eye contact was high, indicating that on average, at least one of the panel members was looking at the mother as she was completing the task: 82% and 87% of the time for the speech and arithmetic task, respectively. In addition, the overall number of unscripted negative and positive interactions were relatively low on average indicating that panelists were adherent to the TSST protocol.

Table 7. Means, standard deviations, and ranges of TSST protocol adherence coding.

Coded Variable	***n* (%)**	***M (SD)***	**Median**	**Range**
Number of Male Panelists				
One	18 (37.5)			
Two	30 (62.5)			
Gender of Chairperson				
Male	47 (97.9)			
Speech Task				
Proportion Eye Contact		0.82 (0.12)	0.83	0.59 – 1.00
Unscripted Negative Interactions		0.39 (0.88)	0.00	0.00 – 4.00
Unscripted Positive Interactions		1.30 (1.98)	1.00	0.00 – 10.00
Time Before Asking Questions (seconds)		217.73 (39.36)	224.50	103.00 – 279.00
Number of Questions Asked		1.71 (0.97)	2.00	0.00 – 4.00
Arithmetic Task				
Proportion Eye Contact		0.87 (0.09)	0.87	0.69 – 1.00
Unscripted Negative Interactions		0.54 (1.17)	0.00	0.00 – 5.00
Unscripted Positive Interactions		1.96 (1.97)	1.50	0.00 – 8.00
Scripted Comments to Induce Stress		3.53 (2.39)	3.00	0.00 – 11.00

Note. Unscripted negative interactions included either panelists' negatively-valenced comments or nonverbal behaviours; Unscripted positive interactions included both panelists' positively-valenced comments or nonverbal behaviours. Please note that for five mothers, the video of panelist behaviours did not record due to technical difficulties.

To further my confidence in the effectiveness of the stress manipulation, I examined the associations among coded panelist behaviours and mothers' levels of perceived stress (Average SVAS), child-blaming attributions, and harsh parenting behaviours. No associations were significant (see Appendix 2). In conclusion, panelists were, on average, adherent to the TSST protocol, and it was not likely that mothers' experience of stress and reported child-blaming attributions and harsh parenting behaviours were affected by non-adherent panelist behaviour.

3.1.4. Data Analytic Plan

Data Screening and Preliminary Analyses.

Data screening procedures and preliminary analyses were identical to those used in Aim 1 of this study.

Main analyses.

Multiple regression analyses were utilized to test the second aim. To test the unique effects of stress, task-based EF skills, and their interaction on child-blaming attributions, a model was constructed predicting child-blaming attributions from relevant covariates, group (as a binary variable; 0 = control, 1 = stress), task-based EF skills, and the interaction between stress and task-based EF skills. If the interaction was significant, simple slopes analyses were conducted to compare the association between stress and child-blaming attributions at different levels of maternal EF (Mean ± 1 SD). To test the unique effects of stress, self-reported EF difficulties, and their interaction on child-blaming attributions, a similar model was constructed and tested, except that the task-based EF skills score was replaced with self-reported EF difficulties.

A third model was constructed to test the effects of stress, task-based EF skills, and their interaction on harsh parenting behaviours. In this model, harsh parenting behaviours were regressed on relevant covariates, group (as a binary variable; 0 = control, 1 = stress), task-based EF skills, and the interaction between stress and task-based EF skills. In the last model that was tested, harsh parenting behaviours were regressed on relevant covariates, group, self-reported EF difficulties, and the interaction between stress and self-reported EF difficulties. Again, significant interactions were probed using simple slopes analyses to compare the associations between stress and harsh parenting behaviours at different levels of maternal EF (Mean ± 1 SD).

These models were checked to ensure that they met assumptions of linear regression analyses. Across these analyses, based on recommendations from Nakagawa (2004), statistically significant findings were carefully interpreted along with consideration of their corresponding effect sizes.

3.2. Results: Aim 2

3.2.1. Data Inspection

The percentage of missing scores for variables utilized to investigate the second aim ranged between 0% to 1.9% across all measures, including potential covariates. Little's (1988) Missing Completely at Random test supported the assumption that data were missing completely at random and that missingness was not associated with participant characteristics, $\chi^2(24) = 15.61$, $p = .902$. Due to the small proportion of missing data, and the fact that data were MCAR, listwise deletion was utilized in subsequent analyses.[10]

The means, standard deviations, and ranges of variables for the stress and the control groups are presented in Table 8. All data were assessed for normality. Valid scores were all in the acceptable range for skewness and kurtosis (|<3| and |<10| respectively). Given that many of the examined variables were discussed previously in Aim 1, only the DVs (child-blaming attributions and harsh parenting behaviours) are discussed in the following section.

Table 8. Descriptive statistics for the stress and control group.

Measures	**Stress (*n* = 53)**		**Control (*n* = 51)**	
	M (SD)	**Range**	**M(SD)**	**Range**
DVs				
Child-blaming Attributions	4.19 (1.41)	1.57-7.09	4.20 (1.46)	1.17-7.11
Harsh Parenting Behaviours	2.74 (1.12)	1.04-5.53	2.35 (0.95)	1.00-4.42

[10] This led to very slight differences in sample sizes across the main analyses (*n*s = 101-104).

Measures	Stress (*n* = 53)		Control (*n* = 51)	
	M (SD)	Range	M(SD)	Range
EF Variables				
Task-based EF Skills	0.13 (0.70)	-2.68-2.01	-0.09 (0.98)	-3.79-1.89
Self-reported EF Difficulties	103.34	71-184	98.49 (18.91)	71-142
Potential Covariates				
Verbal Cognitive Ability (Vocabulary)[a]	53.87 (8.69)	35-80	54.70 (10.93)	29-80
Psychological Symptoms	0.10 (0.93)	-0.89-2.89	-0.10 (0.78)	-0.89-1.65
Child Behaviour Problems	9.51 (6.09)	0-30	9.74 (6.45)	0-28

Note. EF = Executive Functions

No norms were available for the child-blaming attribution or harsh parenting behaviour measures, and therefore outliers were identified as scores at least 3.29 SDs greater or less than the mean of the group (stress or control group). As such, there were no outliers on either child-blaming attributions or harsh parenting behaviours. For outliers on variables already described in the investigation of the first aim, the same procedure was followed to determine whether inclusion of these outliers would alter findings in the investigation of the second aim. I compared the pattern of bivariate correlations among variables, and beta weights in the regression models when the outliers were truncated to 3.29 SDs above or below the sample means (or 3 SDs above or below the normative means if this data were available), as well as when all outliers were non-adjusted. The resulting pattern of findings remained similar, suggesting that the presence of these outliers was unlikely to impact findings. Therefore, instead of truncating scores, I opted to include the unadjusted outliers in the subsequent analyses.

3.2.2. Description of Scores

In the following section, only scores and bivariate correlations that were not already discussed in Aim 1 are described.

In both groups (stress and control), the mean of mothers' child blaming attribution ratings fell at approximately the midpoint of the scale (4.19 and 4.20 for stress and control groups respectively, on a scale ranging from 1 to 10). However, on average, mothers reported relatively low levels of harsh parenting behaviours (2.74 and 2.35 for the stress and the control groups respectively, on a scale ranging from 1 to 7). These scores were comparable to scores reported in non-clinic samples in other studies (e.g., Arnold et al., 1993; Park et al., 2016; Park & Johnston, 2019). Furthermore, examination of bivariate correlations among the DVs and EF variables for the groups combined indicated that, as expected, mothers' child-blaming attributions for child misbehaviours were significantly associated with their harsh parenting behaviour scores, $r(103) = .35$, $p < .001$, replicating numerous previous findings (e.g., Nix et al., 1999; Smith Slep & O'Leary, 1998) and supporting the validity of these measures in this sample. Again replicating findings in previous studies, self-reported EF difficulties (lower EF skills) were associated with more negative child-blaming attributions (Park & Johnston, 2019), $r(103) = .30$, $p = .002$, and harsher parenting behaviours (Crandall et al., 2015), $r(103) = .33$, $p = .001$. However, task-based EF skills were not significantly associated with either child-blaming attributions, $r(103) = .06$, $p = .521$, or harsh parenting behaviours, $r(103) = .03$ $p = .788$.

Next, bivariate associations between the DVs and the EF variables with the potential covariates were examined combining across stress and control groups (Table 9). The associations between these DVs with other variables replicated findings in previous literature, supporting the validity of these measures. For example, maternal psychological symptoms have been linked to more child-blaming attributions and harsh parenting behaviours (e.g., Leung & Smith Slep, 2006; Lovejoy et al., 2000) and child behaviour problems with more child-blaming attributions (Johnston & Freeman, 1997). In addition, maternal verbal cognitive ability was associated with

less harsh parenting behaviours, which is consistent with findings from recent literature (e.g., St. John, Oztahtaci, & Tarullo, 2018). Overall, these correlations provide support for the validity and the use of these measures in the second aim of the current study.

Table 9. Bivariate correlations between DVs and EF variables with potential covariates.

	Child-blaming Attributions	**Harsh Parenting Behaviours**	**Task-based EF Skills**	**Self-reported EF Difficulties**
Verbal Cognitive Ability	.05	-.24*	.32**	-.05
Psychological Symptoms	.43***	.39***	.03	.74***
Child Behaviour Problems	.34***	.17	-.09	.31**
Child's Age	.13	-.08	.16	-.21*
Mother's Age	-.06	-.03	.13	-.12

Note. EF = Executive Functions. Degrees of freedom ranged from 102 to 103 for all reported bivariate correlations. * $p < .05$; ** $p < .01$; *** $p < .001$

3.2.3. Identification of Covariates

Potential covariates were identified for inclusion into the main multiple regression analyses in one of three ways. First, they were identified if they were correlated with either child-blaming attributions or harsh parenting behaviours (DVs) and an EF variable. Based on recommendations by Tabachnik and Fidell (2013), potential covariates that were correlated with an EF or stress variable at greater than .70 were not included due to concerns with violating the assumption of non-multicollinearity. For regressions in which child-blaming attributions were regressed on self-reported EF difficulties, only child behaviour problems were identified as potential covariates (see Table 9)[11]. No covariates were identified by this criterion for regressions in which harsh parenting behaviours were regressed on self-reported EF difficulties. For the regression model in which harsh parenting behaviours were regressed on task-based EF skills, verbal cognitive ability was identified as a covariate.

[11] The correlation between self-reported EF difficulties and psychological symptoms was greater than the .70 cutoff.

Second, covariates were identified if they differed across groups. However, independent samples *t*-tests to compare scores on potential covariates and demographic variables across the stress and the control groups found that there were no significant differences. Therefore, no covariates were included by this criterion.

Third, categorical demographic variables (child gender, marital status, maternal ethnicity, and maternal employment status) that were associated with differences on both a DV and EF variable were included as covariates. An independent samples *t*-test indicated that there were no differences in scores on child-blaming attributions, harsh parenting behaviours, task-based EF skills, and self-reported EF difficulties for child gender or marital status. However, there were significant differences between mothers of different ethnicities (European/North American, East Asian, and Other Ethnicities) on child-blaming attributions, $F(2,101) = 4.50$, $p = .014$, harsh parenting behaviours, $F(2,101) = 5.05$, $p = .008$, and task-based EF skills, $F(2,101) = 7.75$, $p = .001$. Multiple comparisons indicated that East Asian mothers reported harsher parenting behaviours compared to European/North American mothers but did not differ from each other on any other variables. However, the Other Ethnicities group of mothers reported fewer child-blaming attributions and demonstrated lower task-based EF skills compared to European/North American and East Asian mothers. Although I recognize that this Other Ethnicity categorization is not interpretable, to allow for statistical control for these differences in the regression that examined both child-blaming attributions and task-based EF skills, a binary variable was used (European/North-American/East Asian vs. Other Ethnicities). Lastly, mothers who were employed reported less harsh parenting behaviours, $t(100) = -2.12$, $p = .037$ and demonstrated marginally stronger task-based EF skills compared to mothers who were not employed, $t(100) = 1.96$, $p = .053$. Therefore, based on the third criterion, both maternal ethnicity and maternal

employment status were examined as potential covariates in the relevant analyses described below.

3.2.4. Main Analyses

The purpose of Aim 2 was to examine whether experimentally manipulated stress negatively impacted child-blaming attributions and harsh parenting behaviours, and whether maternal EF (assessed as both task-based EF skills and self-reported EF difficulties) moderated the effect of experimentally manipulated stress. Multiple regression analyses were utilized to test these main research questions, resulting in four different regression models. In Model 1, child-blaming attributions were regressed on maternal ethnicity (European/North American and Other ethnicities), group (stress and control), task-based EF skills, and the interaction between group and task-based EF skills. In Model 2, child-blaming attributions were regressed on child behaviour problems, group, self-reported EF difficulties, and the interaction between group and self-reported EF difficulties. In Model 3, harsh parenting behaviours were regressed on maternal verbal cognitive ability, employment status (employed vs. not employed), group, task-based EF skills, and the interaction between group and task-based EF skills. Lastly, in Model 4, harsh parenting behaviours were regressed on group, self-reported EF difficulties, and the interaction between group and self-reported EF difficulties.[12] All main regression models met assumptions of independent errors and lack of multicollinearity, and visual inspection of the scatterplot of residuals and the normal probability plot indicated that the models likely met assumptions of homoscedasticity, linearity, and normality of residuals.

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[12] As mentioned in Aim 1, I recognize the possible inflation of Type 1 error due to running multiple analyses. Instead of using corrections such as Bonferroni corrections, which have been criticized for increasing Type II error rates, following recommendations from Nakagawa (2004), I interpret significant findings along with their corresponding effect sizes (semi-partial correlations).

Across each of the four models, contrary to my hypothesis, experimentally manipulated stress (the Group variable) did not significantly predict either child-blaming attributions or harsh parenting behaviours (Table 10). More specifically, the overall explained variance was marginally significant for Model 1, with only maternal ethnicity significantly predicting child-blaming attributions (mothers who were European/North American/East Asian were more likely than mothers of other ethnicities to endorse more negative child-blaming attributions, $sr_{ethnicity}$ = -.30, medium effect size). The overall explained variance for Model 2 was significant and indicated that mothers with more self-reported EF difficulties (lower EF skills), sr_{EF} = .20 (small effect size), and mothers with children with greater behaviour problems, $sr_{child\ behaviour\ problems}$ = .26 (medium effect size), reported more negative child-blaming attributions.

Table 10. Regression models predicting child-blaming attributions and harsh parenting behaviours.

	ß	***t***	***p***	R^2	R^2 ***p*-value**
Model 1: DV = Child-blaming Attributions (*n* = 102)				.09	.054
Maternal Ethnicity	-.32	-3.09	.003		
Group	-.01	-.112	.911		
Task-based EF Skills	-.10	-.914	.363		
Group X Task-based EF Skills	.01	0.06	.951		
Model 2: DV = Child-blaming Attributions (*n* = 103)				.15	.002
Child Behaviour Problems	.27	2.75	.007		
Group	-.02	-0.21	.834		
Self-reported EF Difficulties	.22	2.13	.036		
Group X Self-reported EF Difficulties	-.01	-0.11	.913		
Model 3: DV = Harsh Parenting Behaviours (*n* = 101)				.12	.027
Verbal Cognitive Ability	-.27	-2.48	.015		
Employment Status	.17	1.63	.106		
Group	.13	1.30	.197		
Task-based EF Skills	.14	1.34	.184		
Group X Task-based EF Skills	-.13	-1.25	.213		

Model 4: DV = Harsh Parenting Behaviours (n = 101)				.14	.002
Group	.15	1.59	.114		
Self-reported EF Difficulties	.30	3.12	.002		
Group X Self-reported EF Difficulties	.07	0.69	.490		

Note. DV = Dependent Variable; EF = Executive Functions

The overall explained variances for Models 3 and 4 also were significant. In Model 3, greater verbal cognitive ability was associated with less harsh parenting behaviours, sr_{verbal} = .24 (small effect size). In Model 4, only self-reported EF difficulties (lower EF skills) were significantly associated with harsher parenting behaviours, sr_{EF} = .29 (medium effect size). All of these significant main effects were in the expected directions. Overall, these analyses indicated that two out of three of my specific hypotheses were not supported; experimentally manipulated stress (group) did not significantly affect child-blaming attributions and harsh parenting behaviours. Furthermore, the interaction between experimentally manipulated stress (group) and EF (either task-based or self-reported) was not significant in predicting child-blaming attributions and harsh parenting behaviours. The only hypothesis that was partially supported was that self-reported EF difficulties (but not task-based EF) were significantly associated with greater child-blaming attributions and harsh parenting behaviours.

3.2.5. Post-Hoc Exploratory Analysis

In summary, findings from the primary analysis suggest that experimentally manipulated stress may not have an impact on child-blaming attributions and harsh parenting behaviours. However, one of the caveats of examining stress as a binary variable (i.e., the stress group vs. the control group) is that this categorization may not be sensitive to the variability of stress experienced by mothers within the two groups. For instance, although on average there was a significant difference in the reported perceived stress between the groups, some mothers in the stress group were nonresponders and reported relatively low levels of stress (e.g., 0 out of 15),

while some mothers in the control group reported relatively high levels of stress (e.g., 14.5 out of 15). In subsequent post-hoc exploratory analysis, I tested the possibility that an effect of group might be demonstrated if only mothers in the stress group who were stressed and mothers in the control group who were not stressed were included in the analysis. At the same time, mothers also reported different levels of stress at different time points during the tasks in the stress and control groups (e.g., in the control group one mother reported a stress level of 10.1 immediately after she was given instructions for the speech preparation task at T1, but then reported a stress level of 0 once she realized she was practicing her speech and doing math on her own in an empty room at T2 and T3). Therefore, I also utilized multilevel modeling (MLM) analysis to examine whether perceived stress at different time points (rather than aggregated across time points), was associated with more child-blaming attributions or harsher parenting behaviours. The following analyses were performed to determine whether these explanations may account for the lack of a significant effect of the stress manipulation on child-blaming attributions and harsh parenting behaviours.

Stress level exclusion.

Regression models were first conducted excluding mothers for whom the experimental or control manipulation of stress was not effective. I utilized liberal criteria such that mothers who were in the stress group who did not report an increase of at least 3 points above their baseline (T0) SVAS score on at least one of T1, T2, or T3 SVAS scores were excluded (n = 43 included), while mothers who were in the control group who demonstrated an increase of at least 3 points at any time point were excluded (n = 39 included). The four main regression models were re-run and results are presented in Table 11.

Table 11. Regression equations predicting child-blaming attributions and harsh parenting behaviours for a subset of mothers who were considered responders for the stress manipulation.

	ß	***t***	***p***	R^2	R^2 ***p*-value**
Model 1: DV = Child-blaming attributions (*n* = 81)				.10	.077
Maternal Ethnicity	-.21	-1.83	.071		
Group	.12	1.11	.269		
Task-based EF Skills	.08	0.58	.565		
Group X Task-based EF Skills	-.16	-1.21	.229		
Model 2: DV = Child-blaming Attributions (*n* = 81)				.14	.019
Child Behaviour Problems	.16	1.36	.177		
Group	.09	0.88	.382		
Self-reported EF Difficulties	.25	2.31	.023		
Group X Self-reported EF Difficulties	-.04	-0.41	.680		
Model 3: DV = Harsh Parenting Behaviours (*n* = 80)				.25	.001
Verbal Cognitive Ability	-.24	-2.10	.039		
Employment Status	.31	2.88	.005		
Group	.20	1.90	.061		
Task-based EF Skills	.39	2.95	.004		
Group X Task-based EF Skills	-.12	-0.96	.340		
Model 4: DV = Harsh Parenting Behaviours (*n* = 82)				.15	.005
Group	.207	1.93	.057		
Self-reported EF Difficulties	.289	2.74	.008		
Group X Self-reported EF Difficulties	.024	0.22	.824		

Note. DV = Dependent Variable; EF = Executive Functions

The overall explained variance for Model 1 was marginally significant, and the overall explained variances of Models 2-4 were significant. Results from Models 1 and 2 indicated that group continued not to have an effect on child-blaming attributions with this subset of mothers. All other effects demonstrated similar patterns as in the main analyses.

In Models 3 and 4, group was marginally associated with harsh parenting behaviours, such that mothers in the stress group were more likely to report harsher parenting behaviours compared to mothers in the control group, providing some support that stress may have an impact on harsh parenting behaviours. In addition, in Model 3, task-based EF skills were associated with harsh parenting behaviours in an unexpected direction (stronger task-based EF

skills predicted harsher parenting behaviours). In all of the models, neither task-based EF skills nor self-reported EF difficulties moderated group to predict child-blaming attributions or harsh parenting behaviours.

Therefore, these analyses indicated that when excluding mothers who were non-responders to the stress/control manipulation, the pattern of findings predicting child-blaming attributions did not change. However, when predicting harsh parenting behaviours, group effects remained small, although their probability level approached significance, sr_{group} = .19 to .21. In addition, in Model 3, there emerged an unexpected inverse association between task-based EF skills and harsh parenting behaviours. Although marginal effects should be interpreted with caution, particularly given that this was an exploratory and post-hoc analysis, these findings support the possibility that with a larger sample size of responders to both stress and control manipulations, or a stronger stress manipulation, an effect of group might be demonstrated, at least for harsh parenting behaviours. However, in these analyses, there was still no evidence of the hypothesized interaction between group and EF.

MLM.

As another means to explore the null findings for group in the main analysis, I ran an MLM analysis to examine whether perceived stress level at different time points, rather than group, was associated with more child-blaming attributions or harsher parenting behaviours.

In each model, the DV (child-blaming attributions or harsh parenting behaviours; measured at T1: after instructions are provided, T2: after the first stressful/control task, and T3: after the second stressful/control task) was regressed on perceived stress (at T1, T2, and T3), task-based EF skills or self-reported EF difficulties, and the interactions between perceived stress and EF, controlling for the same covariates as in the main analysis, each mother's baseline level

of perceived stress (T0), and group[13]. The data structure was such that within-person variables (i.e., child-blaming attributions or harsh parenting behaviours measured at each time point as the DV, and perceived stress measured at each time point as the predictor variable) were considered Level 1 and nested within the Level 2 between-person variables (i.e., EF variables, baseline perceived stress, group, other covariates). Analyses were conducted using R's multilevel model lme4 package (*R* Development Core Team, 2009; Bates, Maechler, Bolker, & Walker, 2015).

Results from the MLM analyses are presented in Table 12. When predicting child-blaming attributions as the DV, Model 1 and Model 2 both indicated that greater perceived levels of stress were uniquely associated with more child-blaming attributions. All other associations were similar to those found in previous analyses. Interestingly, when predicting harsh parenting behaviours, there was a marginally significant interaction between perceived stress and task-based EF skills, but in an unexpected direction. At lower levels of task-based EF skills, there was no association between perceived stress and harsh parenting behaviours ($ß$ = -.02, p = .746). However, at higher levels of task-based EF skills, perceived stress was marginally associated with harsher parenting behaviours ($ß$ = .14, p = .050). This is contrary to the hypothesis that stronger task-based EF skills would buffer an association between perceived stress and harsh parenting behaviours. Again, all other findings were similar to those reported in previous analyses. Together, findings from these analyses indicate that perceived stress, examined at each time point, was associated with more child-blaming attributions but not harsher parenting behaviours. In addition, there was no evidence of the hypothesized interaction (in both the size and direction) between stress and EF across these analyses.

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[13] Group was included as a covariate to statistically control for the different experiences of the stress and control tasks.

Table 12. MLM models predicting child-blaming attributions and harsh parenting behaviours.

	ß	*t*	*p*
Model 1: DV = Child-blaming attributions (*n* = 102)			
Maternal Ethnicity	-.27	-2.89	.005
Baseline Perceived Stress	.11	1.23	.222
Group	-.07	-0.79	.432
Perceived Stress	.15	2.91	.004
Task-based EF Skills	-.08	-0.87	.384
Perceived Stress X Task-based EF Skills	-.02	-0.51	.614
Model 2: DV = Child-blaming Attributions (*n* = 103)			
Child Behaviour Problems	.22	2.29	.024
Baseline Perceived Stress	-.04	-0.35	.728
Group	-.08	-0.88	.381
Perceived Stress	.15	2.99	.003
Self-reported EF Difficulties	.19	1.87	.065
Perceived Stress X Self-reported EF Difficulties	-.001	-0.03	.977
Model 3: DV = Harsh Parenting Behaviours (*n* = 101)			
Verbal Cognitive Ability	-.21	-2.27	.025
Employment Status	.13	1.35	.179
Baseline Perceived Stress	.16	1.79	.077
Group	.05	0.56	.577
Perceived Stress	.06	1.21	.226
Task-based EF Skills	.15	1.59	.115
Perceived Stress X Task-based EF Skills	.08	1.91	.058
Model 4: DV = Harsh Parenting Behaviours (*n* = 104)			
Baseline Perceived Stress	.05	0.48	.630
Group	.11	1.23	.220
Perceived Stress	.04	0.86	.392
Self-reported EF Difficulties	.26	2.53	.013
Perceived Stress X Self-reported EF Difficulties	.01	0.18	.859

Note. DV = Dependent Variable; EF = Executive Functions

3.3. Discussion: Aim 2

To address limitations in the previous literature and from Aim 1, the second aim of this study was to test whether experimentally manipulated stress uniquely affected both child-blaming attributions and harsh parenting behaviours, and whether task-based and self-reported EF were uniquely associated with child-blaming attributions and harsh parenting behaviours. In

addition, I examined whether task-based and self-reported EF moderated the effect of stress on both child-blaming attributions and harsh parenting behaviours. Findings from the main analysis indicated that only my hypothesis that self-reported EF would uniquely predict child-blaming attributions and harsh parenting behaviours was supported. Surprisingly, I did not find a main effect of manipulated stress on either child-blaming attributions or harsh parenting behaviours. Furthermore, and in contrast to findings from Aim 1, task-based EF and self-reported EF did not moderate associations between stress and child-blaming attributions or harsh parenting behaviours.

3.3.1. Stress and Parenting

When stress was manipulated through the random assignment of mothers to either a TSST group or a control group, mothers in the two groups did not differ in their child-blaming attributions nor their harsh parenting behaviours. This finding was contrary to my hypothesis that stress would influence both child-blaming attributions and harsh parenting behaviours, based on findings from previous studies that have demonstrated associations between indicators of stress, such as household chaos and SES, with parenting (e.g., Dodge et al., 1994; Zvara et al., 2014). To interpret this null finding, the following three possibilities should be considered: 1) the manipulation of stress was not strong enough, and relatedly, 2) the manipulation was not ecologically valid, or 3) there were limitations with the measurement of child-blaming attributions and harsh parenting behaviours. I review how each of these possibilities could have impacted the current findings in the following section.

Ineffective stress manipulation.

One possibility for the nonsignificant effect of stress on parenting was that the manipulation was ineffective. As described earlier, I utilized several different strategies in an

attempt to ensure the effectiveness of the manipulation, including extensive piloting and training, verifying panelist behaviours, and demonstrating group level differences that supported the manipulation as successful. Specifically, the analysis of group differences demonstrated that mothers in the stress group reported greater levels of perceived stress than the control group at each time point after baseline. In addition, the coding of panelist behaviours indicated that the panelists had high levels of adherence to the TSST protocol. However, despite the overall group differences and adherence of panelists to the TSST protocol, there was still a proportion of mothers in the stress group (18.9%) who reported low levels of stress, and a proportion of mothers in the control group (23.5%) who reported high levels of stress.

Variability in how individuals respond to the TSST has been demonstrated previously, and a recent review has identified some contributors to this variability, such as genetics, personality traits (e.g., neuroticism), trait anxiety, perfectionism, and how the individual appraises stress (Allen et al., 2014). It is possible that increasing the strength of the manipulation by intensifying the social-evaluative threats (e.g., more intimidating or a greater number of panelists) may have reduced this variability and successfully induced stress in a greater proportion of mothers. I attempted to increase the social-evaluative threat by changing the order of the speech and arithmetic tasks in the TSST with the assumption that mothers would feel more stressed if they were surprised with the arithmetic task as soon as they entered the interview room. There was an increase in the percentage of stress responders following this adjustment, however, it was obviously not sufficient to produce stress in all TSST mothers. Although other changes may have increased stress levels of mothers even further, it should be noted that some mothers responded very strongly to the stress manipulation (e.g., crying, or withdrawing), and a

stronger manipulation may have increased the number of mothers who were unduly distressed and may have led to higher rates of study withdrawal.

At the same time, the fact that 23.5% of mothers in the control group reported higher levels of stress compared to their baseline ratings suggests that the control protocol also could have been made more effective. Several factors may have contributed to the increased stress levels in the control protocol. First, although mothers were told that they would not be recorded and that they would be standing in an empty room, some may not have fully comprehended or believed the instructions and may have felt it strange to be asked to speak aloud in an empty room. Furthermore, mirroring the TSST protocol, mothers were provided with instructions, and then asked to prepare speech topics. This preparation period may have increased stress levels due to uncertainty about what to expect (e.g., what the room would look like, if there was deception). This possibility is supported by pairwise comparisons of stress rating means for the mothers in the control group which indicated that mothers significantly reported more stress at T1 (immediately after the preparation period) compared to T0, T2, and T3. Therefore, modifications to the control task may be necessary to make it less stressful. Such modifications could include a decrease or elimination of preparation time, or, departing from the analogous nature of the TSST and control tasks, and having control mothers engage in an activity such as reading a magazine in a quiet room.

To explore whether difficulties with the effectiveness of the stress manipulation may have led to the null findings in the second aim of this study, I performed post-hoc analyses. First, I re-ran the main analyses including only responders to the stress manipulation. Interestingly, I found marginal effects for group in predicting harsh parenting behaviours. This marginal finding provides some evidence that the effect of stress is diluted when nonresponders

to either stress or control task are included in the analysis, and that with a larger sample of only responders, there may be a significant effect of stress on harsh parenting behaviours. Although most of the other findings in this post-hoc analysis stayed relatively consistent with the main analysis, there did emerge an unexpected significant, but positive association between task-based EF skills and harsher parenting behaviours. It is possible that this association is spurious in nature, particularly given that the correlation between task-based EF skills and harsh parenting behaviours was close to zero and nonsignificant in the larger sample. Replication is called for to clarify this finding.

In another effort to explain the findings from the main analysis, and because mothers reported different levels of stress across the TSST and control manipulations (e.g., some mothers found the arithmetic section very stressful, but did not find the speech section stressful), I conducted an MLM analysis to take into account these differences in perceived levels of stress. That is, perhaps group assignment was not a sensitive enough index to demonstrate effects of stress, and therefore, examining perceived levels of stress at each time point nested within each mother may demonstrate the hypothesized associations between stress and parenting. This allowed all mothers, regardless of group assignment, to be considered in the stress and parenting link. In this analysis, there was a significant association between greater perceived stress and more child-blaming attributions. This association indicates that stress, as mothers subjectively perceived it, and not as I manipulated it, was related to the extent that mothers blamed their child for misbehaviours.

It is interesting that in the post hoc analysis examining responders to the stress manipulation, I demonstrated marginal findings for harsh parenting behaviours, while the MLM examination of perceived stress demonstrated significant associations with child-blaming

attributions. Perhaps perceived stress taps more strongly into mothers' ongoing appraisals of external stressors and their own coping abilities, including their appraisals of reasons behind their child's misbehaviour. In other words, if a mother views herself to be subject to external pressures and unable to cope, she may be more willing to blame her child for presenting further stress in the form of misbehaviours. This relation between perceived stress and child-blaming attributions may have been masked in the group level differences examined in the first post-hoc analysis. However, comparisons across these two post-hoc analyses should be made with caution, particularly given that the first utilized only the responder subset of the sample. Although these post-hoc analyses do not provide clear answers regarding the role of stress, they do suggest that a more effective stress manipulation, a larger sample of responders, or consideration of individualized responses to the experimentally induced stressor, may be needed to detect an effect of stress on both child-blaming attributions and harsh parenting behaviours.

Ecological validity of the stress manipulation.

Perhaps the effectiveness of the TSST was limited by its ecological validity in the current sample. The TSST was chosen as the stress manipulation given its strong evidence for reliability and validity (e.g., Henze et al., 2017; Kudielka et al., 2007) and in an attempt to address concerns from previous studies that have examined stress effects on parenting by manipulating contextual stress through written vignettes (e.g., Krech & Johnston, 1992; Schellenbach et al., 1991). Instead of reading and imagining the experience of a stressor, I aimed to induce stress in hopes that this would produce more realistic and ecologically valid effects. However, although many mothers have likely experienced job interviews, and in fact over half of the mothers in this study were employed, it is possible that I did not find an effect of stress on parenting because the interview stressor was artificial or too far removed from mothers' daily lives to affect parenting.

For instance, perhaps mothers' reactions to the stressor were limited by the novel nature of the laboratory environment, or the contrived interview situation. Also, it is likely unrealistic that mothers would engage in parenting situations during a stressful interview situation. That is, mothers would typically not be interacting with their children during an interview, given that most interviews would be held outside the home and that children would not be present. It is unclear whether this contrived laboratory stressor may have prevented mothers from thinking about and responding to child misbehaviours as they might typically do in real world situations. Other more naturalistic stressors may be more effective in producing effects on parenting. For example, having mothers complete tedious and complicated tasks (e.g., budgeting for the year, filing taxes, or making a meal plan and grocery list) while in a noisy and disorganized environment compared to having mothers complete more simple, non-stressful tasks (e.g., reading) in a clean and quiet environment may be more closely aligned to the types of stress mothers may experience in their day-to-day lives. It is possible that these daily hassles that parents encounter within the home when a child is more likely to be present, in contrast to work-related stressors that parents experience outside of the home, may be more relevant to in the moment parenting attributions and behaviours. Further research using such stress manipulations will allow for more confident conclusions about the effects of stress on parenting.

Measurement of child-blaming attributions and harsh parenting behaviours.

Similar to the limitations of adding descriptions of stress to written vignettes, it also is possible that the analog nature of the child-blaming attributions and harsh parenting behaviour ratings may have limited findings. Many previous studies have utilized and validated vignettes as measures of mothers' attributions and parenting behaviours (e.g., Bugental, Johnston, New, & Silvester, 1998; Johnston & Freeman, 1997; Johnston & Ohan, 2005). For example, Johnston and

Freeman (1997) demonstrated that attribution and parenting responses gathered from child behaviour vignettes were similar to the attributions and responses gathered in response to behaviours of the parents' own children. The benefit of vignette measures is that the child behaviours that serve as stimuli are held constant across parents, however, these behaviours may not be equally representative of how each parent's own child typically behaves. In addition, parents' responses are limited by the available rating options, and these may not fully capture how a parent would respond to their child's misbehaviour. Furthermore, it is possible that stress may not impact hypothetical ratings of attributions and parenting behaviours as much as it may impact mothers' actual interactions with their children. Future studies that use more naturalistic methods of assessing parenting behaviours and attributions will be helpful to address this limitation. For example, following the stress manipulation, mothers' harsh behaviours could be coded during challenging interactions with their children, such as when helping to complete a difficult homework task (e.g., Danforth, Barkley, & Stokes, 1991). Similarly, mothers' attributions could be measured in a more naturalistic, externally valid way by using videotapes of their own child's behaviour as the basis for attributional ratings or spontaneous reports of attributions (Johnston & Ohan, 2005). Therefore, although the current aim did not find effects of stress on parenting as measured through ratings of vignettes (both child-blaming attributions and harsh parenting behaviours), further research using more naturalistic means of assessing parenting may prove fruitful.

Summary.

From the above possibilities, it is clear that more research is needed to address limitations and to be confident in the null findings of the stress manipulation. Post-hoc analyses suggest a marginal effect of stress within the subsample of mothers who responded to the stress

manipulation. Further research using a larger sample of responders and more ecologically valid manipulations of stress and measures of parenting is necessary to further investigate stress effects. At the same time, it is possible that stress does not impact parenting, at least when induced by the TSST. For instance, acute stress, as induced by the TSST, may be less relevant to parenting than more chronic forms of stress (e.g., household chaos). This possibility is discussed further in the general discussion section.

3.3.2. EF and Child-Blaming Attributions

The relations between maternal EF skills and harsh parenting behaviours were consistent with findings from the first aim, such that self-reported EF difficulties were associated with harsher parenting behaviours both at the bivariate level and within the regression analyses, while the association between task-reported EF skills and harsh parenting behaviours was not significant. Mirroring the findings for harsh parenting behaviours, only self-reported EF difficulties were significantly associated with child-blaming attributions (both in bivariate correlations and within the regression analysis). This consistency across the two parenting measures was expected, given the close associations between child-blaming attributions and harsh parenting behaviours demonstrated in the literature (e.g., Nix et al., 1999; Smith Slep & O'Leary, 1998) and posited by the social information processing theory (Milner, 1993). Specifically, when faced with child misbehaviour, parents who offer more negative explanations for their child's behaviour (or child-blaming attributions), also parent more harshly (Milner, 1993). Previous studies also have found that mothers who self-reported greater inattentive and impulsive behaviours (behaviours typically associated with lower EF abilities), offered more child-blaming attributions for child misbehaviour and made less child-crediting attributions for prosocial child behaviour compared to mothers who reported fewer inattentive and impulsive

behaviours (Park & Johnston, 2019). Together, these results suggest that when faced with child misbehaviour, mothers with stronger self-reported EF skills may be more able to consider mitigating factors and thus to regulate and adjust their attributions, as posited in dual-process models of cognition (Andersen et al., 2007). However, similar cautions should be made as in Aim 1. Given that both EF and parenting variables were self-reported, it is possible that shared-method variance may have accounted for the significant links.

3.3.3. Moderating Role of EF

When stress was experimentally induced, there was no evidence that maternal EF skills moderated the effect of stress on parenting, contrary to what I had hypothesized. As previously highlighted, it is possible that the manipulation of stress was not strong enough to demonstrate an interaction effect with EF. However, neither limiting the analysis only to responders, nor considering differences in perceived stress over time in the MLM analysis demonstrated any evidence of interactions between maternal EF and stress. The one exception to this was that in the MLM analyses, a marginally significant interaction between task-based EF skills and perceived stress was found to predict harsh parenting behaviours. But, the direction of this interaction was contrary to expectations, with perceived stress being associated with harsher parenting behaviours for mothers with stronger task-based EF skills. The marginal and post-hoc nature of this finding make it difficult to interpret and further replications are necessary.

Overall, the same considerations that were given to the null findings for stress also should be considered with regard to the nonsignificant findings for the interaction effect of stress and EF. It is possible that the moderating effect of EF skills might be demonstrated with a more ecologically valid stressor and/or more naturalistic measures of child-blaming attributions and harsh parenting behaviours. Perhaps the fact that mothers were not actually experiencing a

typical stressor within a parenting situation meant that they were not motivated to use their EF skills to regulate their child-blaming attributions and harsh parenting behaviours. In other words, compared to being in a true and stressful child-rearing situation where their actions have real consequences for their relationship with their child, mothers in the TSST group may not have felt it necessary to regulate their responses on questionnaire ratings of attributions and parenting behaviours. At the same time, it is possible that these results indicate that EF truly does not buffer the association between acute stress and parenting. Given that this is one of the first studies to examine the interaction between manipulated acute stress and maternal EF in relation to parenting, future studies addressing and further exploring the above possibilities are warranted.

3.3.4. Conclusions from Aim 2

The goal of this study's second aim was to extend previous findings regarding the effect of stress, and the associations of maternal EF with both child-blaming attributions and harsh parenting behaviours. Overall, only my hypotheses regarding the associations between self-reported EF and both child-blaming attributions and harsh parenting behaviours were supported. There was no effect of stress on either child-blaming attributions or harsh parenting behaviours and no interactions with EF. However, post-hoc analyses demonstrated promising avenues of research direction, such as using a stronger manipulation or a larger sample of mothers who respond to the stress manipulation. As one of the first studies to investigate the causal effect of stress on parenting, several suggestions can be considered for future research to further replicate and test these research questions, including utilizing more naturalistic stressors and having mothers interact directly with their children immediately following or during a stressor.

4. General Discussion

Taken together the findings of the overall study show that stress, at least when measured via household chaos, was associated with harsh parenting behaviours, and maternal task-based EF skills buffered this association. At lower levels of task-based EF skills, household chaos was significantly associated with harsher parenting behaviours. This association was attenuated when mothers demonstrated higher levels of task-based EF skills. However, the same results were not replicated when SES was used as an indicator of stress in Aim 1 or when stress was experimentally manipulated in Aim 2. In addition, direct associations between self-reported EF and harsh parenting behaviours were replicated and consistent across the two aims; and self-reported EF difficulties also were significantly associated with more child-blaming attributions. In the following sections, I discuss overall implications and themes to consider across the two aims of this study, as well as the overall strengths, limitations, and future directions.

4.1. Chronic vs. Acute Stress

Across the two study aims, it is possible that the inconsistent stress findings were due to differences between the chronic or acute natures of the indicators of stress. In particular, I focus discussion on household chaos, not SES, as the chronic indicator of stress since I have already discussed the limitations surrounding the measure of SES as a measure of stress in this sample in the discussion for Aim 1 (i.e., due to range restriction and the social context of Canada). Household chaos, as a stressor, reflects a complex and chronic condition, potentially involving long-term difficulties in both individual and family functioning. Household chaos is associated with decreased sleep quality (e.g., McQuillan, Bates, Staples, & Deater-Deckard, 2019), parental psychopathology (e.g., Hur, Buettner, & Jeon, 2015), and the health of romantic relationships (e.g., Bridgett, Burt, Laake, & Oddi, 2013), all of which could interact and transact to influence

parenting behaviours. In contrast, stress as induced using the TSST is acute, and experienced in a discrete situation. Furthermore, acute stress and chronic stress produce different physiological responses, with chronic stress being much more physiologically damaging (Chrousos, 2009; McEwen, 2004). Perhaps the findings from the overall study indicate that it is chronic stress within a close personal or family realm, and not acute stressors, that influence parenting behaviours. Indeed, previous correlational studies that have demonstrated associations between stress and harsh parenting behaviours have utilized more chronic indicators of stress such as household chaos and social disadvantage measured by low SES (e.g., Dodge et al., 1994; Mills-Koonce et al., 2016) rather than acute stress as induced by the TSST. Referring back to the family stress model (Conger et al., 1992), perhaps the mechanisms that lead to harsh parenting behaviours reflect a buildup of stress over time and not mechanisms which are triggered by acute stress.

In contrast, it is possible that acute stress may lead to different types of behaviours, rather than the harsh parenting predicted. For example, Taylor and colleagues (2000) proposed a "tend and befriend" hypothesis, which describes that females may respond to acute stress by nurturing their offspring ("tend") or by affiliating with social groups to reduce danger ("befriend"). Indeed, several recent studies have demonstrated support for this response (e.g., Tomova, von Dawans, Heinrichs, Silani, & Lamm, 2014; von Dawans, Ditzen, Trueg, Fischbacher, & Heinrichs, 2019; Youssef, Bachew, Bissessar, Crockett, & Faber, 2018). For instance, one study demonstrated that, compared to a control group, women in the TSST group demonstrated elevated prosocial behaviour (e.g., trustworthiness and sharing behaviours) in a social decision paradigm (von Dawans et al., 2019). In another study, women demonstrated increases in perspective taking in the stress group compared to the control group (Tomova et al., 2014). When applied to the

current study's second aim, these findings might suggest that mothers who experience the acute TSST stress would become more positive or prosocial towards their child, and/or better able to utilize perspective taking skills to understand their child's behaviour (i.e., less child-blaming attributions). However, this hypothesis was not supported insofar as the stress group, although not demonstrating significantly more negative parenting, also did not show significantly less of this behaviour than the control group.

It is interesting to note that many of the studies supporting the tend and befriend hypothesis only examined the befriend aspect by measuring social responses to peers or strangers from whom participants could potentially receive social support (e.g., von Dawans et al., 2019; Youssef et al., 2018). Support regarding the tend aspect of this hypothesis is less common, although Taylor (2006) indicated that administration of oxytocin (a hormone released in response to stress) leads to enhanced maternal behaviour in animal studies, and increased mother-infant bonding in humans. The literature utilizing the infant crying paradigm as a stressor provides mixed evidence for the tend and befriend hypothesis. Although many parents respond with sensitive parenting behaviours to infant crying stimuli, parents who react with increased physiological reactivity to the stress of infant crying are more likely to use harsh parenting behaviours (Joosen et al., 2013; Out, Bakermans-Kranenburg, van Pelt, & van IJzendoorn, 2012). However, inferences about the effects of stress derived from studies that use infant crying as a stressor are difficult to interpret, given that often the infant is both the stimulus as well as the recipient of parenting responses. It is unclear whether parenting responses to infant crying stimuli can be generalized to parenting responses to other stressors that are independent of the parent-child relationship.

To my knowledge, the current study is one of the first to examine parenting in response to experimentally induced acute stress that is external to the parent-child relationship. Although stress may lead to increased prosocial behaviour with strangers or peers, it is not clear whether acute stress that is external to a parenting situation impacts how mothers respond to their own offspring. Furthermore, little is known about mothers' response to acute stress when interacting with older offspring, given that existing studies using infant crying paradigms have typically focused on mothers of infants and attachment relationships (e.g., Joosen et al., 2013; Taylor, 2006). In contrast to the tend and befriend hypothesis, results from Aim 2 of the current study would suggest modest evidence for increased harsh parenting behaviours in response to an acute, external stressor, however this finding was not robust as it was only marginally demonstrated when the sample was limited to responders to the stress manipulation. Therefore, although the tend and befriend hypothesis may delineate the distinct effects of acute stress on parenting, it has yet to be confirmed and further work is encouraged. For example, since this hypothesis emphasizes increases in more positively-valenced behaviours (e.g., tending and nurturing offspring, seeking social support), it is possible that the effect of acute stress may be more strongly demonstrated on positive parenting behaviours (e.g., warmth and involvement), compared to negative parenting behaviours, such as harsh parenting.

4.2. Task-based vs. Self-reported EF

Another theme that was evident in the current study was the differences between self-report and task-based measures of EF. At the bivariate level, only self-reported EF, and not task-based EF, was significantly associated with child-blaming attributions and harsh parenting behaviours. This finding is consistent with studies that demonstrate that self-reported EF difficulties, and not task-based EF tests, predict real world outcomes such as occupational

functioning (Barkley & Fischer, 2011; Barkley & Murphy, 2011). These associations may speak to the low ecological and predictive validity of task-based EF tests compared to self-reported EF ratings, and it is possible that self-report ratings of EF are more important due to their proximity to daily life impairments (Barkley & Murphy, 2011). However, there also are several limitations to relying solely on self-reported measures of EF. For example, because parenting also was measured by self-report in the two aims of this study, the significant associations between these variables and EF may be somewhat accounted for by shared method variance, reducing the actual strength of this association.

In addition, as reported in Aim 1, self-reported EF was highly correlated with maternal psychological symptoms, accounting for almost 55% of their variance, but it was not associated with either task-based EF skills or verbal cognitive ability, concepts that, in theory, should be more strongly interrelated. The magnitude of these overlapping variances is concerning as it could indicate that self-reported EF is measuring a different variable such as quality of life or psychological impairment, rather than higher order thinking and self-regulation processes (Diamond, 2013), reducing confidence in this form of EF measurement. Relatedly, perhaps the high levels of overlap between self-reported EF, psychological symptoms, and other types of impairment could be accounted for by a third variable such as mothers' lack of self-efficacy. For example, it is feasible that mothers who experience more EF difficulties feel a low sense of self-efficacy in their functioning and lowered self-efficacy has been linked to less parenting sensitivity and warmth (e.g., Teti & Gelfand, 1991), and harsher parenting behaviours (Sanders & Woolley, 2005). However, it also is important to consider that there are high levels of comorbidity between psychological symptoms, EF difficulties, and functional impairments (e.g., Barkley & Murphy, 2010; Nigg et al., 2017; Snyder, 2013), and therefore the magnitude of

overlap between these constructs could be reflecting this comorbidity, while also being bolstered by shared method variance. In sum, although some would argue for the superior ability of self-reported EF to predict meaningful outcomes, including comorbidities and co-occurring functional impairments, it also is possible that this superior predictive and concurrent validity is an artifact of shared method variance with the predicted variable, or high overlap with other constructs, such as psychological symptoms or self-efficacy. Further research demonstrating the discriminant or incremental validity of self-reported EF measures, above and beyond related measures such as psychological symptoms, functional impairments, and self-efficacy, would increase confidence in the use of this method of assessing EF.

In contrast to self-reported EF measures, task-based measures of EF are not influenced by reporting biases and may be a more objective measure of EF. However, task-based measures also are subject to measurement error and task impurity, such that other abilities that are unrelated to EFs (e.g., colour perception, misunderstanding of task instructions) can contribute to performance on EF tasks (Miyake & Friedman, 2012). Despite these limitations, previous studies have provided support for the validity of task-based EF scores by demonstrating significant associations between task-based EF and harsh parenting behaviours across a diverse range of samples (i.e., both lower SES and community samples) and ages of children (ranging from 10 months to 7 years of age; e.g., Cuevas et al., Deater-Deckard & Bell, 2017; Monn et al., 2017; Sturge-Apple et al., 2014). For example, Kao et al. (2018) found that parental task-based EF was significantly correlated with self-reported strictness/overprotectiveness in a community sample. Deater-Deckard and Bell also found significant bivariate associations between a composite task-based measure of EF and a composite measure of parenting that included observed harsh parenting, self-reported harsh parenting, and ratings of child-blaming attributions

in a community sample. Similarly, Azar and colleagues (2017) demonstrated significant bivariate associations between increased task-based EF skills (specifically, cognitive flexibility) and decreased child-blaming attributions, within a sample of more disadvantaged mothers, half of whom had histories of child maltreatment.

Yet, the results are not fully consistent within the literature. Although there are a number of studies that have shown associations between task-based EF and parenting, there also are several studies, including the current study, that do not show these direct associations (e.g., Deater-Deckard et al., 2010; Deater-Deckard et al., 2012b; Sturge-Apple et al., 2014). Similar to the current findings, Deater-Deckard et al. (2012b) demonstrated a nonsignificant bivariate correlation between task-based EF and harsh parenting behaviours, and Sturge-Apple et al. demonstrated a nonsignificant association between maternal working memory capacity and child-blaming attributions. Although examination of these studies indicates no clear differences that may explain the varying patterns of associations, it is notable that the two studies that included the most disadvantaged samples (Azar et al., 2017; Monn et al., 2017) belonged to the group that demonstrated significant bivariate associations between task-based EF with parenting. Therefore, it can be speculated that EF is particularly important in predicting child-blaming attributions and harsh parenting behaviours in mothers who are living in relatively more difficult circumstances. For mothers who are higher in SES, there may be more variability with regard to the importance of task-based EF. Furthermore, the current study is unique in that it examines families of child who are slightly older (ranging from 6-10 years old) than those in previous studies. It is possible that the nonsignificant associations between task-based EF and both harsh parenting behaviours and child-blaming attributions found in this study are accounted for by developmental differences in parenting (Blacher & Feinfield, 2013; Miller, 1995;). Further study

is needed to confirm the presence and direction of associations, as well as what factors may predict the presence or absence of significant associations between task-based EF and parenting.

The overall differences in the pattern of findings for task-based vs. self-reported EF can be considered in light of the theoretical distinctions between the two methods of measuring EF put forth in Toplak et al.'s (2013) review. In particular, Toplak et al. highlighted the lack of correlation between these two methods of measuring EF and suggested that task-based EF tests measure the optimal efficiency of cognitive processing mechanisms used for behavioural control, while self-report measures of EF reflect skills involved in more rational pursuit of goals in typical, everyday situations. Certainly, these differences in definitions could explain why these measures demonstrate different patterns of results, both in their bivariate relations with parenting, as well as their stress-moderating roles. If task-based EF skills reflect the efficiency of underlying or core cognitive skills, they may be relatively less overwhelmed by high-stress situations (compared to the difficulties in goal pursuit reflected by self-reported measures of EF) and thus mothers with stronger task-based EF skills may be more able to regulate behaviours such as harsh parenting when stressed. In support, a recent meta-analysis examining the effects of acute stress on core EFs demonstrated that while stress produced significant detrimental effects on EFs such as working memory and cognitive flexibility, these effect sizes were small in magnitude (Shields et al., 2016).

In contrast, if self-report measures of EF assess difficulties in the extent to which the mother is successful in achieving her goals (Toplak et al., 2013), and if mothers have the goal of more adaptive parenting, this would explain the significant correlation between self-reported EF difficulties and harsh parenting behaviours. If we extend this interpretation to the marginal interaction between self-reported EF difficulties and household chaos in predicting harsh

parenting behaviours in Aim 1, it could suggest that under situations of high chaos, even mothers with higher levels of successful goal attainment are impaired. In support, several studies have demonstrated that acute stress impairs goal-directed decision making and behaviours (e.g., Plessow, Kiesel, & Kirschbaum, 2012; Schwabe & Wolf, 2010). In other words, perhaps mothers have more difficulty in consciously pursuing their goals in the midst of stressful situations, but their core cognitive skills are relatively less affected. Furthermore, the significant association between self-reported EF and child-blaming attributions suggests that if mothers endorse parenting goals that are in line with more adaptive parenting behaviours, mothers with greater self-reported EF skills might be better able to avoid child-blaming attributions to support these goals. However, given the aforementioned limitations with the self-reported EF measure, further research is necessary to confirm this interpretation of the uniqueness and importance of each of these different measures of EF. For example, examination of whether mothers' socialization goals moderate associations between self-reported EF and child-blaming attributions, but not between task-based EF and child-blaming attributions, would provide further support for Toplak et al.'s (2013) hypothesis of the differences between the two methods of measurement. In addition, the relative differences in the effects of stress, both chronic and acute, on core cognitive processing (task-based EF) versus rational goal attainment skills (self-reported EF) has not yet been established, and further research confirming such differences is warranted.

4.3. Study Strengths

One of the main strengths of this study lies in the use of both correlational analysis to replicate previous findings, as well as experimental manipulation of stress in the same sample to further examine the effects of stress. Replication of previous findings increased confidence that the association of stress (as measured by household chaos) and parenting is attenuated by higher

task-based EF skills. In addition, this study addressed limitations of examining only correlational data by using random assignment of mothers to either stress or control groups. As such, this research design allowed for examination of the causal effects of stress on parenting and found that stress, at least when induced by the TSST, does not significantly affect child-blaming attributions or harsh parenting responses. As one of the first studies examining this question, it also provided many important suggestions for future research using experimental designs to examine the effects of stress on parenting.

The use of both task-based and self-reported EF also was a strength of this study. Given that both methods of assessing EFs demonstrate strengths and weaknesses, inclusion of both seems called for, at least until we are more confident in identifying the constructs being assessed and the validity of each measure. In this study, by using both measures of EFs, I was able to examine their different patterns of findings across analyses; self-reported EF was directly associated with child-blaming attributions and harsh parenting behaviours, while task-based EF did not show direct associations to parenting, but significantly buffered the association between household chaos and harsh parenting. As well, these results provided suggestions with regard to uncovering the distinct roles of task-based and self-reported EF. Future studies examining the unique predictive validity of task-based EF and self-reported EF may be helpful in confirming that both measures contribute unique and meaningful variance to real-world outcomes such as parenting, as Toplak et al. (2013) proposed.

Furthermore, I also extended the research by examining child-blaming attributions in relation to stress and EF. Although research on parenting cognitions has been growing, many studies still focus specifically on parenting behaviours. However, given that child-blaming attributions have been identified as important determinants of parenting (e.g., Nix et al., 1999;

Park et al., 2016), and given the dual-process model of cognitions that describes a potential link between EF and child-blaming attributions, further investigation of these associations is important. In this study, I demonstrated a link between self-reported EF and child-blaming attributions, as well as a link between how much stress mothers perceived (regardless of which stress group they were in) and child-blaming attributions. This is an important addition to the literature, and points to the need for further research on stress and EF that includes child-blaming attributions as well as harsh parenting behaviours.

Another strength of this study is the cultural diversity within my sample, increasing the generalizability of results. Compared to previous studies that included a majority sample of mothers who identified as European/North American (e.g., Deater-Deckard et al., 2012b; Sturge-Apple et al., 2014), my sample included a larger proportion of mothers who reported East Asian ethnicities, or other ethnicities (e.g., South Asian, Aboriginal) and the proportion of mothers who reported European/North American ethnicities was less than 50%. This ethnic distribution is reflective of the ethnic diversity within Vancouver (Statistics Canada, 2017b). However, further research with specific cultural groups may be important to investigate any cultural differences in associations among stress, EF, and parenting.

Lastly, many previous studies examining the associations among stress, EF, and parenting behaviours have examined these relations in parents of younger children (ranging from 10 months to 7 years of age; e.g., Cuevas et al., 2014; Deater-Deckard & Bell, 2017). The current study is unique in that it examines mothers of older children (6-10 years old). Given that parents parent their children differently as their children grow older (Blacher & Feinfield, 2013), this study serves to extend findings from the literature to families of children who are older.

4.4. Limitations and Future Directions

The findings from both Aim 1 and Aim 2 of this study should be considered in light of several sample and methodological limitations. Although I attempted to over-sample for mothers who were lower SES, the proportion of these mothers in my sample was quite small. On average, my sample was relatively advantaged and well-adjusted. Therefore, it is uncertain how these results would generalize to more disadvantaged families, or to clinical samples. In particular, it is possible that the nature of my sample made it difficult to evaluate SES as an indicator of stress. However, it is encouraging to note that the stress-buffering effects of task-based EF was demonstrated in my sample, as it has been in more disadvantaged samples (e.g., Monn et al., 2017, Sturge-Apple et al., 2014), providing stronger evidence for the generalizability of this finding.

Furthermore, my sample was limited to mothers. In the parenting literature, fathers often have received less consideration, although this trend has slowly been changing (Pleck, 2012). I chose to examine mothers to allow for increased comparability to previous studies (e.g., Deater-Deckard et al., 2012b; Sturge-Apple et al., 2014), especially because these studies have demonstrated inconsistent findings with regard to the moderating role of EF in samples of mothers. However, it will be important to replicate and investigate findings with fathers, particularly given the evidence that there are differences in how men respond to acute stress compared to women (e.g., Tomova et al., 2014; Youssef et al., 2018). For example, Tomova et al. (2014) demonstrated that, although stress increased women's ability to empathize with others, stress increased egocentricity and resulted in less adaptive regulation in men. Based on this study, it is possible that acute stress may have a more detrimental impact on the parenting of fathers compared to mothers, which is a hypothesis that could be investigated in future research.

The overall effect sizes demonstrated in this study were small, including the effect sizes for the stress manipulation. Future studies may need to include larger samples to account for the variability of stress response in mothers and to demonstrate significance of these small effects. Although potentially reducing the external validity of the experimental manipulation, future studies also could select mothers based on their likelihood of responding to the stress manipulation (similar in concept to the stringent eligibility criteria used in efficacy trials). For example, trait anxiety and neuroticism have been identified as predictors of an individual's response to stress (Allen et al., 2014) and could be utilized to identify mothers who would be more susceptible to stress inductions.

Methodological limitations of this study include the use of self-report measures of parenting, household chaos and EF. Although parents may be the most knowledgeable reporters of their own parenting, EF, and home environment across a wide range of situations and over time, they also are subject to biases and other limitations in reporting (Bornstein et al., 2015). Furthermore, interpretations of findings are limited because of the possibility that shared-method variance might be inflating associations. Future research could address this limitation by using observational measures of parenting and home chaos to increase objectivity of these measures. For example, having mothers play a difficult game with their child with a timed component compared to a more relaxing task with no timed component may allow for more accurate observations of their parenting behaviour in a situation that involves stressful demands.

The issues surrounding the method and specification of EF measures contributes to another limitation in this study. Specifically, there is still a lack of consensus surrounding the correct structure, definition, and components of EF. For example, a recent systematic review and re-analysis of data from 10 adult samples indicated that although no model was perfect, there

was most support for a nested factor model, involving a unidimensional EF construct, with specific working memory and cognitive flexibility factors (Karr et al., 2018). Other researchers also have identified an additional category of "hot" EFs, which involve components of motivation and emotional regulation (e.g., Rubia, 2010; Zelazo, Qu, Kesek, Calkins, & Bell, 2010). In the current study, the EF tasks I used targeted only two EFs, and scores were combined to form a composite task-based EF measure. The decision to combine scores was supported by their significant intercorrelation and by previous studies that have made similar decisions (e.g., Deater-Deckard et al., 2012b; Kao et al., 2018). However, inclusion of a more thorough battery of task-based EF measures would more accurately reflect the multidimensional structure of EF and allow investigation of specific and unique associations between different components of EF and parenting. For example, there is very little research on the association between hot EFs and parenting, and it is possible that mothers who struggle to delay impulsive and more immediately rewarding responses may engage in harsher and more punitive behaviours over and above associations with other types of EFs. Further research including a broad range of EFs and examining their unique associations with parenting is warranted.

EF tasks also are notorious for task impurity, such that each EF task typically involves the measurement of multiple EF abilities along with measurement error and nonexecutive abilities (Miyake & Friedman, 2012). Future research may benefit from utilizing multiple EF measures as indicators of specified latent constructs, according to factor structures that are most supported in the literature (Karr et al., 2018). The use of latent constructs would allow for adjustment for measurement error in the EF tasks, and more accurate estimates of associations between a latent EF variable and parenting (Kline, 2016).

With regard to the stress manipulation, and as mentioned previously, the findings from this study provide important suggestions for future studies examining the effect of stress on parenting. For example, it is possible that performing a speech and arithmetic task in front of student judges was too far removed from typical parenting situations to have resulted in strong effects on parenting. This possibility could be tested by using a more naturalistic stressor (e.g., planning meals for the week in a noisy environment) and control task (e.g., reading a magazine in a quiet environment).

Another possibility would be to utilize other study designs to examine associations between stress and parenting. For example, rather than the cross-sectional and correlational designs often used, longitudinal designs or daily diary studies may allow researchers to make stronger inferences about the associations between stress and parenting. For instance, using a daily diary over the course of 7 days to examine associations between daily stressors and parent-child conflict, Nelson and colleagues (2017) found that household chaos and relationship stress each predicted higher levels of parent-child conflict. Although this design still does not allow for full causal inferences, it provides the ability to examine contextual factors and parenting in their natural environment and reduces the memory biases that are typically present when parents are asked to report on overall parenting or stress (Nelson et al., 2017). It would be interesting to extend these findings by examining whether EFs moderate associations between these daily dairy ratings of stressors and parenting behaviours.

Lastly, because the second aim of the current study was designed to explore the general effects of stress, defined as the subjective experience of being unable to cope with a stressor, on parenting, I did not measure mothers' physiological responses to the stress task. However, similar to studies that have examined the association between maternal autonomic nervous

system responses to infant crying and harsh parenting (e.g., Joosen et al., 2013; Reijman et al., 2014), it is possible that stress will differentially spillover into parenting depending on mothers' physiological stress responses. Future research that examines the effects of acute stress on parenting may benefit from including such measures of physiological reactivity during the stressor and examining these measures as potential mechanisms or moderators for the effects of stress on parenting.

4.5. Clinical Implications

Before discussing potential clinical implications, it is important to interpret the findings from the current study in the context of the small effect sizes across analyses and acknowledge that there are limited implications until studies can demonstrate larger effect sizes. Although the results highlight the potential roles that household chaos and EF have within parenting, the small effect sizes also suggest that these variables are only a small part of a larger system of transacting determinants of parenting (e.g., Belsky's, 1984 buffered system of parenting). Consideration of other important parenting variables, such as parents' socialization goals (e.g., Hastings & Grusec, 1998) or their own socialization experiences (e.g., Simons, Beaman, Conver, & Chao, 1993), may elucidate further the network of associations. Furthermore, there are many other factors outlined in Belsky's (1984) model that may be contributing to findings (e.g., cultural background of the family, marital stress/support, personality traits). As such, future research and clinical application of other factors that are operative in influencing parenting should be completed in conjunction with that of stress and EF. However, if findings are replicated with larger effect sizes using the modified methodology suggested by this study, the following potential clinical implications for parents who struggle with managing external stressors and/or their EF skills can be considered.

First, there might be utility in the development of a household chaos intervention, which provides guidance to parents on how to organize and de-clutter their homes and more effectively schedule household routines. Such a chaos intervention might prove helpful in reducing parent stress levels and thereby increase the uptake and application of more effective parenting strategies. Comparing this intervention to a placebo or alternate treatment would indicate effects of chaos reduction on parenting, and measurement of parents' EF within the trial would allow investigation of EF as a moderator of treatment outcome. If such an intervention reduces stress levels of parents and decreases their harsh parenting behaviours, this would provide stronger evidence for the causal effects of household chaos on parenting.

With regard to interventions to improve EF skills, limited evidence suggests that stronger EF skills can be developed through regular training on specific EF tasks (e.g., Jaeggi, Buschkuehl, Joindes, & Perrig, 2008), although this type of intervention has been demonstrated to require significant effort and the effects are highly domain specific (Crandall et al., 2015). Perhaps a more effective route would be to focus specifically on maternal problem solving and cognitive flexibility skills on an applied level within the context of parenting, rather than at a task level. That is, instead of focusing on training performance on EF tasks (e.g., WCST or Matrix Reasoning), perhaps assisting mothers with being able to generate and search for mitigating information when their child misbehaves (i.e., applied cognitive flexibility), as well as to generate and evaluate multiple solutions when faced with childrearing problems (i.e., applied problem solving) may be a more effective intervention. For example, Bugental and colleagues (2002) found that mothers who received an enhanced home visitation intervention that included cognitive strategies to improve applied problem solving were less likely to engage in child abuse compared to mothers who received the regular home visitation intervention. It is possible that

providing practical training focused on problem solving or cognitive flexibility in parenting situations, and thus increasing mothers' applied EF skills, may attenuate the effects of stress on parenting. These are exciting possibilities to consider in developing and evaluating future interventions.

5. Conclusion

Given the ubiquitous nature of stress in the parenting role, it is important to identify the impact that stress has on parenting, and variables that can mitigate any negative effects. Crandall et al. (2015) expanded upon Belsky's (1984) seminal model of parenting and Conger et al.'s (1992) family stress model to specifically highlight the importance of parental EF as a bulwark for the effect of stressful circumstances on parenting. The findings from the current study provide support for this model such that greater task-based EF skills attenuated the association between household chaos and harsh parenting behaviours. This finding replicates two previous studies, which used different indicators of stress (e.g., SES and perceived stress) in more disadvantaged samples (e.g., Monn et al., 2017; Sturge-Apple et al., 2014), increasing the overall confidence in the presence and generalizability of this finding. Furthermore, the study provided general support for the effects of stress on harsh parenting behaviours (in the significant association between household chaos and parenting and the marginal effects of stress on parenting in responders to the stress task), as well as the direct associations between EF and child-blaming attributions and harsh parenting behaviours (specifically, self-reported EF difficulties). Together, the findings from this study suggest that stress affects how mothers respond to their children, and that mothers' EF skills are an important individual difference variable that may work to mitigate negative childrearing practices. Given the well-established connection between harsh parenting behaviours and negative child outcomes (e.g., Hipwell et al., 2008; McLeod et al., 2007; Rothbaum & Weisz, 1994), this study contributes to the important next step of exploration of the complex network of determinants and moderators of parenting.

It is clear, however, that further research is needed to confirm and strengthen these findings, and the current findings must be interpreted cautiously in light of the small effect sizes.

This study was one of the first studies to utilize an experimental stress induction to investigate the effects of stress on parenting. Although the stress manipulation was not entirely successful in demonstrating these effects on parenting, valuable insight was gained to guide future research, including the need for more naturalistic stressors and the inclusion of a broader variety of EF measures to more comprehensively capture the EF construct. Such research will further illuminate these relations and add to our growing conceptualization and understanding of the larger system of transacting and interacting determinants of parenting.

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Appendices

Appendix 1

Coding Manual for TSST Panelists

# Males	Indicate how many males are included in the panel
Gender of chairperson	Indicate whether the chairperson is a male or female
Eye Contact	Using a stopwatch, time the duration of time when at least one panelist is looking at the participant
Total time	Record the total duration of the speech task, and of the arithmetic task
Neutral off-script comments	To code this, one must be familiar with the TSST script. Please note any comments that were stated that were off script, but where the chairperson stays in character (i.e., neutral). These can include things like "Please try your best" or any answers to mothers' questions that are not denoted in the script (e.g., re-explaining the instructions in a neutral way
Negative off-script comments	Record the number of comments that were off-script and could be interpreted as overly negative. E.g., "Put your hands at your side" in a directive or commanding way
Positive off-script comments	Record the number of comments that were off-script that are positively valenced. E.g., "Absolutely, you can go to the washroom!"
Negative non-verbal	Record the number of negative nonverbal actions that the panel member might make. For example, checking the timer in an obvious way, or shaking head or frowning.
Positive non-verbal	Record the number of positive nonverbal actions. For example, smiling, laughing, or nodding.
Minutes before asking questions	Record how many minutes have passed from when the timer starts for the speech, until the time when the chairperson begins to ask questions
Which questions asked?	Note down which questions are asked by the panelist. Refer to the document "List of TSST Questions" for what number is linked to which question
# Added Comments (Arithmetic)	Note how many added comments or corrections are provided in the arithmetic section. Do not include the comments about incorrect responses, instead include things like "Please make eye contact" or "Please do not use your hands" etc. These are comments that are permissible in the script. Therefore, they are different from the neutral/negative/positive off-script comments code
Notable participant behaviour	Tally up instances when the participant's behaviour is notable (e.g., if the participant leaves the room, or begins to cry). Ignore smaller comments such as "this is so stressful" or "I'm not good at this". Only note down anything that may lead to more off-script comments from the panelists or pauses in the task administration.

Appendix 2

Table 13. Bivariate correlations between coded variables from the TSST and average perceived stress, child-blaming attributions, and harsh parenting behaviours.

	Average Perceived Stress	**Child-Blaming Attributions**	**Harsh Parenting Behaviours**
Speech Task			
Proportion Eye Contact	.055	.111	.118
Unscripted Negative Interactions	.107	-.156	-.045
Unscripted Positive Interactions	-.072	-.038	-.166
Time Before Asking Questions (seconds)	.233	.211	.039
Number of Questions Asked	-.215	-.187	-.124
Arithmetic Task			
Proportion Eye Contact	-.034	.023	.132
Unscripted Negative Interactions	.175	.226	.176
Unscripted Positive Interactions	.046	-.112	.039
Scripted Comments to Induce Stress	.065	-.016	-.122

Note. None of these bivariate correlations were significant at $p < .05$