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The Relationship Between Maternal Emotion Socialization and Child Executive Functioning and Behavior: Exploring the Moderating Role of Cortisol

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The Relationship Between Maternal Emotion Socialization and Child Executive Functioning and Behavior:
Exploring the Moderating Role of Cortisol

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Contents

Abstract

In the early years of life, the development of children's executive functioning (EF) and behavior regulation are critical to their later growth and self-sufficiency. Previous studies have indicated that one pathway by which children learn to regulate their emotions is through their immediate social environments (de Cock et al., 2017). Parents, in particular, play a significant role in the development of their children's emotion regulation and executive functioning (Fernandes et al., 2022). At the same time, physiological responses to stress also matter. Cortisol, the end product of the hypothalamic-pituitary-adrenal axis, has also been associated with children's executive functioning and behavior regulation, such that higher cortisol is associated with poorer executive functioning in children (Wagner et al., 2016). In addition, stress also leads to higher levels of behavioral problems (Dettling et al., 1999). However, the extent to which social and biological factors interact is poorly understood. Therefore, this study aims to explore further the relations among maternal emotion socialization, children's physiological response to stress, and children's executive functioning and behavior. Mothers completed the Coping with Children's Negative Emotions Scale to assess their response to their children's negative emotions and the Behavior Rating Inventory of Executive Function-Preschool Version (BRIEF-P) and Child Behavior Checklist on their children's EF and behavior. Children also completed performance-based tasks on their executive functioning. Results suggest a main effect of maternal emotion socialization on children's EF ($B = 12.91$, $SE = 3.12$, $p < .001$) and internalizing behavior ($B = 3.52$, $SE = .584$, $p < .001$) and externalizing behavior ($B = 6.74$, $SE = 1.30$, $p < .001$). Specifically, higher levels of unsupportive socialization were associated with increases in EF problems as assessed via the BRIEF-P and increased behavioral problems. However, there was no main effect of cortisol and no significant interaction between parenting and cortisol. These findings support existing research that maternal emotion socialization influences the development of executive functioning and child behavior regulation with implications for intervention research.

Introduction

Executive functioning (EF) is an umbrella term used to describe several cognitive processes humans use daily. There is no cohesive or mainly agreed-upon definition for EF except that it constitutes three overarching processes: working memory, inhibitory control, and cognitive flexibility (Carlson et al., 2013). EF includes problem-solving, controlling impulsive behavior, planning and organizing, initiating and staying on task, and simulating situations outcomes–hypotheticals/ “what if” scenarios (Tang et al., 2014). These skills are utilized to exhibit control over thoughts and behavior, therefore, playing a significant role in self-regulatory processes. While EF compromises various skills that mainly revolve around cognitive processes, it also has been implicated in social awareness and emotion regulation (Zelazo & Cunningham, 2007). In the current study, I will examine the relationship between parenting and children’s stress reactivity as indexed by cortisol on indicators of EF.

The Development of Executive Functioning

Since EF is a battery of complex processes, its development is not solely affected by one factor, thus being associated with both social and biological factors (Bernier et al., 2012; Blair, 2016). It is influenced by nature, such as genetics, and nurture, like parental style, environment, and culture. For instance, socioeconomic status, a nurture element, plays a role in access to certain resources and the school environment in which children learn. A lack of financial resources may cause stress to parents, interfering with the quality of their parenting and how they interact with their child(ren) (Haft and Hoeft, 2018; Hutchison et al., 2016). More specifically, being in poverty interferes with the development of a healthy brain which has been implicated in leading to deficits in EF in low SES students (Hackman et al., 2015; Hodel, 2018). In contrast, genetic factors, like the presence of certain neurotransmitters, play a role in the self-regulation elements of EF (Sun et al., 2018). Specifically, a lack of EF indicates atypical developmental and potential learning disabilities; EF deficits can indicate clinical outcomes like attention deficit disorder (ADD), autism spectrum disorder, or depression (Snyder, 2013).

Biological Processes

There is a neurological aspect to the development of EF as well (Blair, 2016). Neurological development begins before children are even born, as the mother's prenatal health is crucial to the developing fetal brain. The formation of the prefrontal cortex is especially crucial to the development of EF(Carlson et al., 2013). Neural plasticity is a huge aspect of such development because without the development of the prefrontal cortex, the essential brain regions tied directly to EFcannot provide the necessary support to help people utilize those skills (Zelazo & Carlson, 2020). There are three key prefrontal cortex circuits underlying EF: the dorsolateral, orbitofrontal, and anterior cingulate circuits.

The dorsolateral circuit of the prefrontal cortex regulates abstract thinking, working memory, and higher-level processing (Hetrich et al., 2021). Though abstract thinking and higher-level processing are typically utilized more heavily later in life, there cannot be a basis for these processes without their initial development in simpler situations. The dorsolateral circuit will aid in cognitive flexibility in adjusting to unfamiliar situations and reframing behavior and actions to fit the scenario, which helps children learn new information (Brosnan & Wiegand, 2017). Impairment in this area usually illustrates struggles with controlling inhibiting behavior, including the restraint of potentially inappropriate behaviors, preventing irrelevant information from coming to the forefront, and removing irrelevant information that would currently be accessible by working memory (Barbey et al., 2012; Nejati et al., 2021).

The orbitofrontal circuit of the prefrontal cortex aids in emotion regulation and risk and reward understanding (Camille et al., 2004). The ability to control impulsive behavior and simulate the consequences of hypothetical scenarios are controlled by this area, emphasizing the importance of executive function in processes that we may normally associate with different structures (i.e., associating emotional reactions with the amygdala rather than the prefrontal cortex). However, this circuit has reciprocal connections with limbic structures like the amygdala and hippocampus, and these structures work together in emotion regulation, memory, and emotional memory (Rempel-Clower, 2007). The orbitofrontal cortex is also important to the reward circuit, outlining what decisions and behaviors would likely result in a reward (Rolls et al., 2020). Thus, the orbitofrontal cortex is activated when children are working to make a decision, such as assessing whether stealing a cookie from the cookie jar is worth it.

The anterior cingulate circuit of the prefrontal cortex plays a significant role in error monitoring and social evaluations (Bush et al., 2000). Again, when considering simulating the consequences of hypothetical situations, controlling impulsive behavior, learning from your mistakes, and problem-solving abilities, the anterior cingulate is important in someone's ability to have control over these skills (Posner et al., 2007). Specifically, the anterior cingulate will help people realize what behavior is appropriate for a certain situation; it helps them determine the best way to respond despite ways that may be worse. The anterior cingulate has a significant role in the risk and reward system of the body, this circuit largely influences how children make decisions, helping them avoid risky behaviors and pursue decisions that result in rewards (Hadland et al., 2003). In addition, the orbitofrontal circuit is important for integrating emotional information into thinking, working in tandem with the anterior cingulate for evaluating social situations and determining the best course of action (García-Cabezas & Barbas, 2017).

The Assessment of Executive Functioning in Children

Children's EF is typically determined in two main ways– through performance-based measures or surveys and rating measures. For example, the Behavior Rating Inventory of Executive Function-Preschool Version (BRIEF-P; Sherman & Brooks, 2010) is a rating measure that parents, teachers, or daycare providers can fill out to assess their child's EF. The BRIEF-P offers the perspective of a child's EF in an everyday context–home, preschool, and/or daycare–by measuring inhibition, cognitive and attentional flexibility, working memory, emotional control, and planning/organization. A measure like the BRIEF-P allows for a better understanding of how a child is performing daily in their environments and how their EF plays a role in their ability to do so. However, because the BRIEF-P is a self-report measure, it is subject to reporter bias and may not represent accurate portrayals of children's EF.

In contrast, performance-based measures are a real-time depiction of a child's EF skills. Children are given specific tasks that test their EF skills. For instance, a task like Day/Night asks children to say the opposite of what they see, initiating their cognitive flexibility and inhibitory control. Thus, when children are asked to complete EF tasks in real time, it is a more accurate demonstration of the development of the EF skills they have learned in school or at home. However, these tasks only evaluate a child's EF at that moment, not necessarily considering the factors that could impact their performance. Children know they will take tests in a lab setting and may act or approach the test differently due to the unique circumstances. One example of a performance-based task is Simon Says. This task requires kids to utilize their working memory, response inhibition, and task-shifting skills to successfully complete the tasks. Children must effectively take their time to be patient and closely listen to the directions to avoid the wrong motion at the wrong time. Often, children are really excited to complete tasks like this, and sometimes, it is hard for students to exhibit control and show their focus during such activities because they are so excited. Children may become shy if they are performing the task in front of something they do not know, or they may shut down if they mess up one aspect of the task. They may even attempt to impress the person giving them the task, seeking validation from them, and they perform poorly or well. Therefore, performance-based tasks make it much more difficult to accurately measure a child's EF and may not actually reflect a child's EF capacity. Combining the two methods in a study allows a more thorough assessment of children's EF skills and how certain factors impact said performance.

The Role of Physiological Biomarkers

Physiological biomarkers are a more objective way to measure the health of our body and its overall functioning and can help researchers circumvent the limitations of other methodological approaches in their design. Cortisol is a physiological biomarker and our body's primary stress hormone. Because cortisol indicates our body's stress levels, it helps us understand how our body utilizes the hormone in times of stress. Cortisol levels are high in various instances, including activities such as intense physical exercise or feeling extremely overwhelmed by multiple impending deadlines. Even before babies are born, cortisol levels play an integral role in their development. When babies are in their mothers' uteruses, they are impacted by their mother's cortisol levels. In a research study conducted by Braren et al. (2021), higher prenatal parent cortisol linkage supports the development of infant executive function, whereas lower prenatal cortisol levels indicate a risk to that development. This research has indicated a positive relationship between maternal-paternal diurnal cortisol and infant executive function scores, such that the children of parents with a lower linkage will have higher EF (Braren et al., 2021). Another study by Wagner et al. (2016) revealed that higher salivary cortisol is associated with poorer EF in preschool children. Results also concluded that there was an association between children with poor self-control and flexibility and parents with higher stress levels (Wagner et al., 2016). The relation between these two factors suggests a bidirectional relationship between parenting stress and the development of child EF, such that parents have higher salivary cortisol levels when their child is struggling to develop their EF. In turn, children will also have higher cortisol levels, impacting the strength of their EF skills (Dettling et al., 1999; Wagner et al., 2016). Given the results of both of these studies, promoting child EF skills could decrease the stress of both children and parents while improving the quality of life for both parties.

Parental Role in Executive Functioning Development

As aforementioned, neuroplasticity, formal education, and physiological biomarkers are only some of what children need to develop strong EF skills. The foundation for the majority of these skills is developed in their formative years around family members and their homes (Fay-Stammbach et al., 2014). Parents, siblings, and other relatives who may live in the home significantly impact the development of these skills and much more. Children grow up picking up the structure of thought-processing, behaviors, and attitudes from the people around them (Stormshak et al., 2000). Older siblings often speak of how their younger siblings copy their every move, frequently doing things they did not even realize they picked up like a hand on the hip or explaining their actions through hand gestures. Therefore, early relationships, especially those with their parents, are critical in children's EF development.

The strength of EF in children largely depends on the nurture given by parents (de Cock et al., 2017; Sosic-Vasic et al., 2017). Parenting style and parental responsiveness play important roles in the nurture that children experience and, thus, the development of their EF skills. In the first years of their lives, children are especially sensitive to environmental influences like their caregiving (de Cock et al., 2017). The bond between parents and their children can predict the outcome of their academic performance, emotion regulation skills, and cognitive skills. Parents' bonds with their children are often established through their behavior towards them, which is influenced by their dispositions to act and the interpretation of their child's needs in line with their own goals as parents. For instance, parental scaffolding is considered to be a positive parenting behavior because parents provide extra support in their children's learning. A specific example of this may be a child recognizing a letter and a parent assisting their child in teaching the sound of the letter and the words associated with the letter. Another example includes parental stimulation, which is where parents are responsive to their children's cognitive, emotional and physical needs. One of the ways in which they do so is by utilizing flashcards to show them how to learn words, numbers, and concepts. Parental sensitivity, mind-mindedness, and control have been linked to children's more complex and later EF skills (de Cock et al. 2016). Caregiving behaviors like this foster the development of children's self-regulatory and EF skills when the behavior illustrated is assuring, consistent, and stimulating (Schroeder & Kelly, 2010). In addition, when parents have weak bonds with their children, they are more likely to have poor social and emotional skills and exhibit a difficult temperament (de Cock et al. 2016).

When parents do not use positive parenting strategies with their kids, children are more likely to grow up struggling to have a handle on their cognitive, social, emotional, and behavioral abilities. Consequently, some children face maltreatment. These children are vulnerable to psychopathology after enduring maltreatment from their parents, heightening their stress responses and increasing their allostatic load (Fay-Stammbach & Hawes, 2019). The accumulation of chronic stress negatively affects the development of their cognitive abilities, reducing their capacity to regulate their EF skills and prefrontal cortex functions of volitional attention and thought (Fay-Stammbach & Hawes, 2019). Existing research–collected via self-report surveys or through performance-based tasks– has implicated that there are deficits in EF for preschool children who have been abused (Cipriano-Essel et al., 2013; Jacobs et al., 2010). Most research did not include both self-report measures and performance-based tasks to analyze the level of the preschoolers' EF, making it difficult to conceptualize how mistreatment particularly affects different age groups (of children). Thus, a study conducted in 2019 aimed to examine the EF of preschool children exposed to maltreatment utilizing the BRIEF-P and performance-based tasks and the associations between caregiver reports versus actual student performance on EF tasks (Fay-Stammbach & Hawes, 2019). By employing a multi-method study, researchers were able to not only contribute to the limited literature but also expand knowledge on how the two particular methods may reflect maltreatment's varying impact on EF. The results of the study indicated that caregiver responses on the BRIEF-P were significantly associated with child performance on the tasks. However, the results were inconsistent regarding associations between specific indices of EF and performance-based tasks. All in all, these results showed that children exposed to maltreatment exhibited poorer EF on the performance tasks and as indexed by the BRIEF-P and suggests that the two methods capture distinct elements of EF (Fay-Stammbach & Hawes, 2019).

Culture also plays a role in the behaviors that parents develop. When people grow up with parents who enforce certain expectations that are reflected in their culture, then their children often adapt those same practices to their own form of parenting. Of course, culture is not linear and can be influenced by things like globalization, technological development, and social media (Lansford, 2022). For instance, some Chinese parents used to believe that shyness is a desirable trait for their children to possess because they associate it with social competence and fitting in with a group (Chen, 2019). However, with the increasing presence of Western principles, some Chinese parents now believe that shyness is a representation of social incompetence and change their behavior to illustrate that shyness is an undesirable trait to avoid (Chen, 2019). Depending on the cultural habits of parents, their practices will impact the development of the EF of their children. For instance, East Asian schools structure their curriculum on cultural heritage, thus reinforcing the emphasis on obedience and self-control in the classroom. They also emphasize inhibition through delayed gratification tasks like asking the child to wait until the research assistant is back to eat the marshmallow (Kochanska et al., 1996).These elements of culture could be why East Asian students have higher performance scores in inhibitory control tasks (Oh and Lewis, 2008). In contrast, Western culture places more significant emphasis on practices of individualism, independence, self-expression, and recreation (Parmar et al., 2004). Therefore, children who attend western country schools complete tasks that encourage self-expression like painting or making music with items in the room. Numerous studies have found differences in the development of EF and the illustration of said skills once they enter primary school (Tran et al., 2019).

Because most studies focus on parental behaviors rather than the parental emotions and feelings towards their children, it leaves a lot unknown about the impact of parental bonding and specific emotional responsiveness. In reality, a parent's emotional response towards their child can have just as strong of an effect as their behavior. Responsive parenting, which is parents' use of emotions to interact with their children, is associated with advanced EF in children's behavior (de Cock et al., 2017).

One way parents' emotional interactions with their children are understood is with the CCNES. The Coping with Children's Negative Emotions Scale (CCNES) is a measure where children or parents are given twelve scenarios in which children could exhibit negative emotions (Fabes et al., 2002). For each scenario, parents and kids are asked to indicate how the parent would respond to the child's emotions. The measure includes six different subscales: distress responses (DR), emotion-focused (EFR), expressive encouragement (EE), minimization reactions (MR), problem-focused reactions (PFR), and punitive reactions (PR). The DR subscale assesses the parent's likelihood of becoming adversely aroused or distressed by their child's negative emotions. The EFR scale assesses the parent's ability to help their child feel better. The EE subscale assesses a parent's ability to actively encourage their child's expression of negative emotions. The MR subscale examines a parent's likelihood to discount or devalue their child's negative emotions or problems. The PFR subscale looks at when a parent helps their child solve the problem that caused them distress. The PR subscale evaluates a parent's ability to use verbal or physical punishment to control the expression of negative emotion. Altogether, the subscales provide a good picture of a parent's responsiveness to their child and their emotion regulation. The measure helps to examine the specific ways in which parents respond to their child's negative emotions and how parents' responses influence the development and outcome of their child's social and emotional outcomes. More specifically, measures like the CCNES, give insight into parental emotion socialization- a construct that highlights parents' reactions to their child's negative emotions.

Research has shown that mothers have a large impact on the emotion socialization of their children; their reactions to their preschoolers' emotions, discussions of emotions, and emotional expressiveness within their family influence their children's play a major role in the development of their socialization (Denham et al., 1994). Maternal reactions to preschoolers' negative emotions reflect their expectations of their children's emotional expression and regulation (Jin et al., 2017). Mothers respond with more sensitivity to their children's negative emotions compared to their positive ones (Suh & Kang, 2020). A mother's reaction to her child's negative emotions has the capacity to directly impact the development of their child's emotion regulation because they look to their mothers to provide the knowledge and comfort they need (de Cock et al., 2017). If mothers ignore or minimize their children's negative emotions, children will experience difficulty properly controlling their emotions. The inability to control their emotions may lead to illustrations of aggression, anger, and other things. Therefore, if mothers are supportive in response to their children's negative emotions, the support will result in a healthy foundation for them to know to behave properly in tough social situations. Developing mechanisms of proper emotional knowledge will equip kids with social and emotional competence that they may not have been able to establish without the teaching from their mothers (Suh & Kang, 2020). Thus, if preschoolers learn to manage their emotions and recognize them properly, they will be able to resolve social conflicts using appropriate methods, not resorting to things like aggression (Fernandes et al., 2022). Therefore, positive maternal emotion socialization gives children a better chance at thriving in their environments, utilizing their EF to guide them throughout life.

The Fernandes et al. (2022) study was curious to explore the relationship between caregivers' reactions to their children's distress and EF because there is a lack of knowledge on the connection between parental responsiveness and children's EF. Parental responsiveness was assessed using the CCNES to understand the impact of the mothers' reactions to their children's negative emotions and how their responses affect the development of their emotion regulation.

Because emotion regulation influences EF, the CCNES is a great tool to examine parents' role in EF. The BRIEF-P was utilized to examine child EF, making itself distinct from other studies by utilizing all subscales instead of just the emotional control subscale. What made the study even more unique was that the researchers included parents' and teachers' scores of these children to gain a more well-rounded understanding and perspective on their EF skills. Because EF looks differently in a school and home setting, and school may demand higher expectations of EF than being around family. The inclusion of both parties aids in the credibility of the study's design and highlights the impact of different caregivers' on children's EF. The results of this study implicated that maternal negative emotion regulation strategies were associated with difficulties in impulse control, inhibition, and flexibility of modulation of responses, emotions, and behavior (Fernandes et al., 2022). Teachers' BRIEF-P assessments of their students' and mothers' negative emotion response strategies implicated poor EF in children, particularly in inhibition, working memory, and planning/organizing. These findings corroborated other studies that also found that caregivers' behaviors and encouragement of EF skills relate to the scores children received on EF (Bernier et al., 2010; Landry et al., 2002). Overall, they found that non-supportive emotional responses to children's distress likely provide a social environment where children are not to practice and develop emotion regulation skills, thus negatively affecting their EF (Fernandes et al., 2022).

Child Behavior and Emotion Regulation

Child behavior is strongly correlated with EF, which is tied to emotion regulation and the knowledge of how to respond in social situations. Without EF, children cannot control their emotional regulation (Reilly & Downer, 2020). There are intrinsic and extrinsic factors of emotion regulation. Intrinsic factors include temperament and EF aspects like attention and inhibitory control; extrinsic factors include a child's living environment, sibling and peer relationships, and cultural expectations of emotional display (Fox & Calkins, 2003). These factors are correlated with child behavior, arguably making it a reflection of a child's emotion regulation abilities.

Children's behaviors are categorized into two types: internalizing and externalizing. Internalizing behaviors are characterized by inner-directed feelings and can include being nervous, irritable, withdrawn, sad, lonely, or unwanted (Hinshaw et al., 1992). Externalizing behaviors are characterized by negative actions directed toward the environment, including physically assaulting someone, lying, or substance abuse (Hinshaw et al., 1992). When children struggle with their behavior, they are exhibiting emotion regulation deficits. For example, children who feel the need to throw tantrums and scream or kick at their parents do not have a good sense of emotional regulation. Their first idea of resolving an issue is to react irrationally with their bodies rather than sit back and take the time to process their feelings. Children with good emotion regulation will likely want to react with an emotional outburst but will instead use coping mechanisms like telling their parents why they feel the way they feel or walking around their house to process what just happened (Doan & Wang, 2018). The lack of emotion regulation is why poor preschool EF is associated with internalizing and externalizing problem behavior (Rose et al., 2018; Sulik et al., 2015).

Parental emotion socialization practices like criticism, punishment, and neglect contribute to children's internalizing behavior development and continuance (Lins et al., 2021). Irritability and other non-supportive reactions to their children's emotions from parents may dissuade them from sharing their emotions, ultimately leading children to suppress them. Over time, children will lose the opportunity to learn how to manage their emotions from their parents. Children may also demonstrate externalizing behaviors, leading to more common physical or emotional outbursts. Inversely, if children are encouraged to express their emotions and progressively become more skilled at handling emotionally demanding situations, they will exhibit less internalizing behaviors and take their teachings to others around them (Lins et al., 2022; Nooner et al., 2018).

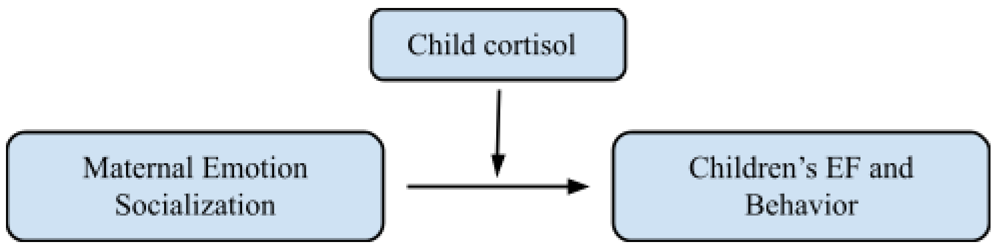
Various psychological measures assess a child's emotions and behavior. The Child Behavior Checklist (CBCL) is a widely used questionnaire to assess behavioral and emotional problems in children, working to assess both elements. The CBCL comprises seven syndrome subscales, a subscale for sleep problems, and the emotionally reactive and internalizing and externalizing broadband (Achenbach and Rescorla, 2001). The seven syndrome subscales comprise two broader subscales, internalizing (the anxious/depressed, withdrawn/depressed, and somatic subscales) and externalizing behavior (aggressive behavior and attention problems subscales). Each subscale asks parents to rate the likelihood of their children feeling or performing a certain way or behavior from not true to very true (0-2). The subscales provide a good picture of children's emotion regulation and typical behaviors. The measure helps examine the specific ways in which parents perceive their child's emotions and behaviors and how parents' behavior and responsiveness can influence their kids' portrayal of these things.

The Current Study

In this study, I examine both biological (cortisol) and social factors (parenting) in predicting EF. Specifically, this study will assess the relationship between maternal emotion socialization and cortisol on child EF (using both state and trait levels) and behavior (internalizing and behavior). I also explore the interaction of parenting and child cortisol.Child cortisol moderates the relationship between maternal emotion socialization and children's EF and behavior, such that cortisol exacerbates the relationship between the two.

Figure 1

Proposed Moderation Model of Study



Methods

Participants

Participants included 167 mothers who ranged in age from 22 to 48 years old (*M* = 32.13; *SD* = 7.62) and their children (*M* = 3.83, *SD* = 0.56, 50.3% male, and 49.7% female). Mothers were recruited via flyers asking for their participation in the study. Flyers were posted in toddler and mommy-friendly places like daycares, gyms, community pools, mommy-stroller clubs, and libraries during story time. Mothers were paid $50 for each lab visit. Ninety-nine participants were white (59.2% of the sample), and sixty-eight participants were non-white (41.8% of the sample). Mothers' highest education levels varied from having a high school diploma to a graduate degree, with the majority of participants having a bachelor's degree (30.1%). Household incomes ranged from less than $20,000 to greater than $175,000; the majority of participants were in the $20,000 to $60,000.

Procedure

Mothers filled out a questionnaire with the CCNES, BRIEF-P, and CBCL. These survey questions assessed their maternal emotion socialization and their perception of their child's EF and behavior regulation. They also completed a health history questionnaire for their children and answered a variety of demographic questions, including the following: their age, child age, child gender, race, education level, and household income level. Children completed three different EF performance-based tasks: the pencil tap, day/night, and head-toes-knees-shoulders. Their salivary cortisol was collected at four different time points while experiencing mild stressors like separation from their mother or watching a scary video.

Measures

Coping with Children's Negative Emotions Scale (CCNES)

Maternal emotion socialization was assessed using the Coping with Children's Negative Emotions Scale (CCNES). The CCNES (Fabes et al., 1990) is a self-report measure in which mothers and fathers respond to 12 hypothetical situations in which their child expresses distress (e.g., "If my child loses some prized possession and reacts with tears, I would …"). Mothers indicated the likelihood of each of six possible responses to the situation ranging from 1 (*very unlikely*) to 7 (*very likely*). The measure yields 6 subscales with adequate test-retest correlations between time 1 and time 2: problem-focused reactions, ("help my child think of places he/she hasn't looked yet", $\alpha = .78$), emotion-focused reactions ("distract my child by talking about happy things",$\alpha = .80$), expressive encouragement ("tell him/her it's OK to cry when you feel unhappy", $\alpha = .85$), distress reactions ("get upset with him/her for being so careless and then crying about it", $\alpha = .70$), minimization reactions ("tell my child that he/she is over-reacting", $\alpha = .69$), and punitive reactions ("tell him/her that's what happens when you're not careful", $\alpha = .77$). The subscales were grouped into supportive and unsupportive groups. For this study, only the unsupportive group, comprised of the minimization and punitive reactions categories, was assessed.

Behavioral Inventory of Executive Functioning for Preschool Children

Children's EF was assessed using the Behavior Rating Inventory of Executive Function - Preschool Version (BRIEF-P). The BRIEF-P is a rating scale given to parents to measure behavioral manifestations of children's EF in everyday life (home and preschool). The BRIEF-P is a 63-item standardized questionnaire for parents and teachers that examines EF in their preschool aged children (Cronbach's $\alpha = .80$ to $.90$) (Sherman & Brooks, 2010). Moms were asked to rate items (e.g. is unaware when he/she does well and not well, acts too wild or out of control, etc.) on a scale of 1 to 3 ("Never", "Sometimes", "Often"). The following are the eight subscales and a global executive composite of the BRIEF-P: inhibit, shift, emotional control, working memory, plan/organize, inhibitory self control index, flexibility index, and emergent metacognition index. Only the global executive composite score of all eight subscales was used in this study (α = 0.95).

Child Behavior Checklist (CBCL)

Child behavioral and emotional problems were assessed using the Child Behavior Checklist (CBCL). The Child Behavior Check- list for ages 1 1/2 to 5 (Cronbach's α = .95) will be used to assess internalizing and externalizing behaviors (Achenbach and Rescorla, 2000). Mothers indicated whether their child displayed any of the 100 behavioral descriptions in the last 2 months on a 3-point scale (0 not true, 1 somewhat or sometimes true, and 2 very true or often true). The following are the two subscales and two broad band scales of the measure: syndrome subscales- Aggressive Behavior (α = 0.92), Anxious/Depressed (α= .62), Attention Problems (α = .67), Somatic Complaints (α = .61), Withdrawn/Depressed (α = .59), and Stress (α = .65); extra subscales - sleep problems (α = 0.68) and emotionally reactive (α = .79); broadband-internalizing, the sum of anxious/depressed, withdrawn/depressed, and somatic complaints scores (α = .78), and externalizing, the sum of attention problems and aggressive behavior (α = .92). The entire measure is also summed (α = .95). In this study, the internalizing and externalizing scales were used.

Performance-Based Tasks

Children's EF ability was assessed with three tasks: 1) pencil tap, 2) sun/moon, and 3) Head-Toes-Knees-Shoulder (HTKS) task. In the pencil tapping task, the experimenter taps twice and the child is expected to tap once; when the experimenter taps once, the child is asked to tap twice (16 trials). In the sun/moon task, children are asked to say “day” when presented with a picture of the moon, and to say “night” when presented with a picture of the sun (16 trials). In the HTKS task, children are asked to touch their toes when instructed to touch their head, touch their head when instructed to touch their toes, touch their knees when instructed to touch their shoulders, and to touch their shoulders when instructed to touch their knees.

Cortisol

Children’s cortisol samples were collected via saliva. To collect children’s saliva, with assistance from the investigator, children were asked to mouth a 6-in sterile cotton rope, placing it underneath their tongue. The saturated end will be cut and placed into a needleless 10-cc plastic syringe and expressed into a plastic vial, marked with participant ID, and stored in a portable cooler. To collect saliva from parents, moms and dads will be asked to spit approximately 1 mL into a sterile, plastic vial, which will be marked with their participant ID and immediately stored. Samples will then be frozen for temporary storage before assay. When data collection is complete, all saliva samples will be sent to the University of Trier for assessment. The University of Trier will also be responsible for disposing of all samples. We have worked with the University in previous studies and they follow standard protocol for analysis and disposal of saliva samples. Children’s saliva was collected at five time points, including after the parent-child free play (baseline), as well as at approximately 15, 30, and 45 minutes after baseline.

Results

Once data was collected, it was scored and cleaned. Before any descriptives or correlations were run, assumptions were checked to see if the data were normally distributed. Data was transformed and winsorized as necessary according to the data distribution. The cortisol data were winsorized and log-transformed. The cortisol and maternal response data were centered prior to creating the interaction term. Correlations of all variables were run prior to conducting analyses. Finally, regressions were run on the relationship between maternal socialization, cortisol, and child EF and behavior.

Upon examining the relationship among all variables using correlation analysis several relationships were revealed, as reported in Table 1. There was a significant correlation between child performance on EF tasks and child ($r = .21$) and mom ($r = .28$) age. The strongest correlations of the regression analysis were between the unsupportive CCNES and the BRIEF-P ($r =.44$) and the internalizing ($r = .47$) and externalizing ($r = .48$) scales of the CBCL.

Hypothesis Testing

Next, I examined the main effects of unsupportive emotion socialization and cortisol along with the moderation of cortisol on each of the child's outcomes (EF and behavior). All models controlled for child age and mother education level, income, and sex.

A linear regression was run in R to test the main effect of maternal emotion socialization on child EF on performance-based tasks. The unsupportive subscales of the CCNES were not significant predictors of children’s EF on performance-based tasks ($p = .489$).

Table 1

Descriptive Statistics and Correlations

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11
1. Child Age	3.83	0.56											
2. Mom Age	32.13	7.62	.13 [-.04, .29]										
3. Child Gender	0.50	0.50	-.01 [-.17, .16]	-.02 [-.17, .14]									
4. White	0.57	0.50	-.17* [-.32, -.00]	.00 [-.16, .16]	-.05 [-.20, .11]								
5. Education	3.60	1.40	-.02 [-.18, .15]	.34** [.19, .47]	-.11 [-.26, .05]	.19* [.03, .34]							
6. Income	4.65	2.59	.08 [-.09, .24]	.42** [.29, .55]	-.06 [-.22, .10]	.23** [.07, .38]	.50** [.37, .61]						
7. CCNES_unsupp	2.11	0.67	.05 [-.14, .24]	-.06 [-.24, .12]	-.13 [-.30, .05]	-.28** [-.44, -.11]	-.06 [-.23, .13]	.12 [-.07, .29]					
8. AUCGMWINZ	278.30	109.85	-.01 [-.20, .19]	.07 [-.11, .25]	.02 [-.16, .20]	-.02 [-.20, .17]	.12 [-.07, .30]	.08 [-.11, .26]	-.10 [-.29, .10]				
9. EFtask	0.00	0.88	.21* [.05, .37]	.28** [.13, .42]	.11 [-.04, .26]	.13 [-.03, .28]	.09 [-.07, .24]	.10 [-.06, .25]	-.16 [-.33, .02]	.01 [-.17, .19]			
10. GEC_BRIEFP_STAR	37.65	18.75	-.08 [-.26, .11]	.01 [-.17, .19]	-.23* [-.39, -.05]	-.03 [-.21, .15]	-.02 [-.20, .16]	-.06 [-.24, .12]	.44** [.27, .57]	-.10 [-.28, .10]	-.18* [-.34, -.00]		
11. Internal_CBCL_STAR	4.95	4.17	-.01 [-.18, .17]	.07 [-.10, .23]	-.12 [-.27, .05]	-.19* [-.34, -.02]	.04 [-.12, .21]	-.02 [-.19, .15]	.47** [.32, .60]	.05 [-.13, .24]	-.11 [-.27, .05]	.46** [.31, .59]	
12. External_CBCL_STAR	12.24	8.68	-.07 [-.24, .10]	.10 [-.07, .26]	-.13 [-.28, .03]	.01 [-.16, .17]	.04 [-.13, .20]	.07 [-.10, .24]	.48** [.33, .61]	-.10 [-.28, .09]	-.14 [-.29, .02]	.63** [.51, .73]	.60** [.49, .70]

Note. *M* and *SD* are used to represent mean and standard deviation, respectively. Values in square brackets indicate the 95% confidence interval for each correlation. The confidence interval is a plausible range of population correlations that could have caused the sample correlation (Cumming, 2014). * indicates $p < .05$. ** indicates $p < .01$.

Similarly, there was no moderating role of cortisol. The overall model had an $R^2 = .061$, suggesting that the data explained 6.1% of the variance in the model. See Table 2 below for the results of this regression analysis.

Table 2

Regression Analysis of EF Performance Tasks

	Estimate	*SE*	*p*
Intercept	-0.79	0.58	.177
Child's Age	0.23	0.16	.084
Child Gender	0.10	0.20	.532
Education Level	0.01	0.07	.917
Household Income	0.01	0.04	.695
Race	0.04	0.20	.831
Unsupportive CCNES	-0.16	0.13	.215

A linear regression was run in R to test the main effect of maternal emotion socialization on child EF in everyday life as indexed by the BRIEF-P. The unsupportive subscales of the CCNES were significant predictors of children's EF via their parents' reports on the BRIEF-P ($B = 12.90$, $p = .004$). Next, an interaction term was added to test the moderating role of cortisol. Maternal emotion socialization and child EF based on the BRIEF-P were not moderated by cortisol. The overall model had an $R^2 = .22$, suggesting that the data explained 22% of the variance in the model. See Table 3 below for the results of this regression analysis.

Table 3

Regression Analysis of BRIEF-P

	Estimate	*SE*	*p*
Intercept	49.60	13.20	<0.001
Child's Age	-2.36	3.09	.445
Child Gender	-5.23	3.79	.171
Education Level	0.12	1.54	.939
Household Income	-0.57	0.83	.494
Race	3.53	4.49	.435
Unsupportive CCNES	12.90	3.12	<.001

A linear regression was run in R to test the main effect of maternal emotion socialization on child internalizing behavior. The unsupportive subscales of the CCNES were significant predictors of children's internalizing behaviors ($B = 3.52$, $p < .001$). Next, an interaction term was added to test the moderating role of cortisol. Maternal emotion socialization and child internalizing behavior were not moderated by cortisol. The overall model had an $R^2 = 0.37$, suggesting that the data explained 37% of the variance in the model. See Table 4 below for the results of this regression analysis.

Table 4

Regression Analysis of Internalizing Behavior

	Estimate	*SE*	*p*
Intercept	6.96	2.59	.009
Child's Age	-0.51	0.59	.398
Child Gender	-0.37	0.73	.621
Education Level	0.36	0.30	.240
Household Income	-0.278	0.17	.094
Race	-0.34	0.89	.705
Unsupportive CCNES	3.52	0.58	<0.001

A linear regression was run in R to test the main effect of maternal emotion socialization on child externalizing behavior problems. The unsupportive subscales of the CCNES were significant predictors of children's externalizing behaviors (B = 6.74, $p < .001$). Next, an interaction term was added to test the moderating role of cortisol. Maternal emotion socialization and child internalizing behavior were not moderated by cortisol. The overall model had an R^2 = 0.30, suggesting that the data explained 30% of the variance in the model. See Table 5 below for the results of this regression analysis.

Table 5

Regression Analysis of Externalizing Behavior

	Estimate	*SE*	*p*
Intercept	17.80	5.74	.003
Child's Age	-1.72	1.32	.197
Child Gender	-0.55	1.64	.736
Education Level	0.99	0.67	.145
Household Income	-0.69	0.38	.164
Race	0.17	1.97	.931
Unsupportive CCNES	6.74	1.30	<.001

Overall, a mother's unsupportive reactions to their children's emotions impact the development of their EF and the presence of internalizing and externalizing behaviors. However, cortisol levels do not affect, or specifically worsen, the relationship between maternal emotion socialization and child outcomes.

Discussion

The aim of this study was to understand the relationship between maternal emotion socialization and child EF and behavior. The exploration of the moderation of cortisol in this relationship was included in determining if a physiological marker could change the impact of the relationship between a mother's emotion socialization and the development of their child's outcomes. While cortisol has been implicated in impacting the nurturing relationship of other factors in other studies (Blair et al., 2011), the results have indicated that nurture (i.e., parenting) is more influential in this current study. Maternal emotion socialization, as assessed through the CCNES, predicted child EF and behavior, whereas cortisol levels did not impact child outcomes. This finding is inconsistent with previous research that implies that cortisol can moderate the relationship between maternal emotional socialization and EF and behavior in children in some sense (Blair et al., 2017). The lack of cortisol's impact on the relationship between the parenting-child outcome in this study could have been caused by the activities the children experienced. Salivary cortisol was collected after specific interventions, such as after children watched a scary video or were separated from their mothers. Thus, it is possible that the tasks were not intense enough to induce the necessary salivary cortisol to deduce a moderating effect of the stress hormone.

In addition, the lack of a main effect or moderation of cortisol could have been because cortisol was studied as a moderator in the primary relationship (i.e., change the impact one variable would have on another) instead of a mediator (to explain the relationship between the predictor and outcome variables). For instance, child cortisol has been found to mediate the relationship between prenatal maternal mood and EF in boys (Neuenschwander et al., 2018). Other research has suggested that a positive mediation relationship would encourage the development of a positive bond between mother and child, aiding in the development of the children's EF (Braren et al., 2021; de Cock et al., 2017; Gonzalez et al., 2012; Wagner et al., 2016). These results illustrate that cortisol does not necessarily serve as a protective factor against negative life events. The lack of moderation from cortisol in the present study calls into question the established strength and general effectiveness of cortisol as a predictor of developmental factors. A future study could examine the mediation of cortisol at three different time points, possibly producing an effect of cortisol and providing a better understanding of the hormone's impact on the relationship between parenting and child outcomes over prolonged periods.

This study's results further supported research linking maternal response to child negative emotions to the development of their children's EF and behavior regulation. Maternal emotion socialization predicts child EF and behavior (Fernandes et al., 2022; Lins et al., 2021; Suh & Kang, 2020). Mothers' response to their children's exhibition of negative emotions is crucial to their understanding of regulating emotions. With a lack of support from their mothers, children struggle to associate negative emotions with potential positive outcomes, thus not learning how to conquer emotionally draining and demanding situations (Suh & Kang, 2020). Children look to their parents, especially their mothers, to teach them how to respond to certain situations (Fay-Stammbach & Hawes, 2018; Suh & Kang, 2020). When parents react negatively to their children's negative emotions or behaviors, it encourages children to engage further in their actions (Suh & Kang, 2020). For example, if children exhibit externalizing behavior like a temper tantrum, and their mom chooses to punish them instead of walking through their feelings, it creates a cycle of this behavior for the child. The child does not have the opportunity to learn the difference between effective problem solving, thus showing them to react before they think.

Without realizing it, mothers not supporting the development of their children's EF development and the growth of their social and emotional awareness in their preschool years permanently affects them for the rest of their lives. Yielding the same results in this study only strengthens the existing research that maternal responsiveness plays a significant role in developing vital skills for their children (Bernier et al., 2010; Gonzalez et al., 2012; Suh and Kang, 2020).

Strengths and Limitations of The Current Study

This study has numerous strengths and limitations. The use of the BRIEF-P survey is a strength because it is a measure of everyday EF and is more reflective of what parents notice about their child's abilities outside of more formalized situations, like the performance-based tasks they completed at the lab. In addition, the BRIEF-P's established validity and use across various studies further establish its credibility as an EF assessment tool. Though self-report surveys are typically taken with a grain of salt because of their response bias, this study highlights their significance. In contrast to the EF performance tasks, the BRIEF-P was a more accurate measure of EF children's when considering parents' perceptions of their EF. Typically, parents will be more biased toward their child's EF, having a narrow-minded view of their child's actual abilities. The results of this study demonstrate that even with that bias in place, child performance did not showcase the child's EF abilities as parents may have reported, thus further solidifying the BRIEF-P as an accurate report of child EF. These findings also illustrate the importance of employing a multi-method approach because it suggests that the survey and performance-based tasks measure different aspects or levels of EF, even if intended to assess the same things.

Still, this study relied heavily on the use of other self-report questionnaires (CCNES & CBCL). As previously stated, self-report questionnaires are subject to response bias, possibly causing mothers to respond in a non-honest way to look good in the eyes of the researchers. Thus, mothers may not have accurately reported their children's EF abilities, behavior, or response to their children's negative emotions. Mothers also may not have understood the consequences of their behavior and how their emotional responsiveness impacted their children, inadvertently causing them to give what they believed were authentic representations of their parenting (Bornstein et al., 2015). Despite their potential bias, these surveys provided a well-rounded and comprehensive look into how mothers respond to their children's emotions. This insight may not have been obtainable in other tasks or mere observational aspects of the study (i.e., watching the limited interactions between mother and child in between study tasks). Such surveys provide glimpses into the reality that may not be otherwise accessible in a traditional laboratory or research setting.

The performance-based tasks also had strengths and limitations. The EF tasks effectively measured inhibitory control and cognitive flexibility because they allowed children to demonstrate if they could utilize their EF in less traditional settings. Previous literature has shown that performance-based EF tasks in real-time represent a child's actual EF abilities and help supplement parents' perceptions of their children's EF (DePasquale et al., 2020). However, the results do not support this idea; maternal emotion socialization did not predict child performance on EF tasks. These results suggest two things: 1) mothers' unsupportive responses to their child's emotions do not impact the relationship between their performance on EF tasks, and 2) performance tasks may not measure the same elements of EF that the BRIEF-P does even if they are intended to. Because mothers' unsupportive maternal socialization does not predict child performance on EF tasks, their supportive responses may be more predictive of child performance, or they may not have an impact. Or other factors, like introducing tasks to strengthen their EF, may play a significant role and be more predictive of child performance. Another possibility of the tasks not conveying child EF abilities is the environment in which they were tested. While being tested, children were around people they did not know without the presence of their parents. For some children, it may have been really exciting to be around someone unfamiliar; they may have wanted to impress them, distracting them from the then-current task. Others could have been shy, causing them to not demonstrate their EF abilities. The environment could have also been too controlled and not aligned with their typical learning environment, negatively impacting children's performance on the tasks and not accurately presenting their EF skills. However, the lack of maternal emotion socialization predicting child performance on the EF tasks does not diminish the importance of the tasks' inclusion in this study. It further highlights the significance of having a two-method approach to test how children's EF differs based on environment and what specific aspects of EF are being tested when utilizing tasks compared to surveys (Andrews et al., 2021).

The study only included maternal emotion socialization rather than parental emotion socialization. Only having mothers in the study could introduce bias about the impact of their parenting behavior compared to their partners. Despite there being research that establishes the importance of mother's reactions to their children's negative emotions, there is also research that implies that fathers play an equally important role (de Cock et al., 2017; DePasquale et al., 2021; Lucassen et al., 2015; Towe-Goodman et al., 2014). Including more people–other parents, immediate family members, or teachers– who can testify to children's EF and behavior and parents' emotion socialization would give a more well-rounded and hopefully less biased image of the interaction between parent and child(ren). Future studies could include testing the other immediate members of the child's family to better understand the gravity of different people's behavior on the children around them EF and behavior regulation. This study could also have observational measures that look at how the parents react in everyday settings rather than specifically answering vignettes about their children's emotions. Adding more observational elements to the study may eliminate the chances of parents intentionally altering their behavior to fit a certain image that would make them more favorable to researchers or the study's results. Examples could include videoing the interaction between parents and children when there is not an explicit task occurring.

Lastly, the study lacked participant diversity. The majority of participants were white (59.2% white, 41.8% non-white), not reflecting the experiences of families of color. White experience and upbringing often do not equal the experiences of families of color; hence, the results do not explain how being a person of color changes the development of EF and behavior regulation.The study barely included Black families or indigenous families, and it did not specify what the "mix" was when there were mixed families. Thus, it leaves a lot to be misunderstood about the relationship between maternal emotion socialization and child behavior and EF in different ethnic families.

Overall, a future research study could examine if the difference in parenting is based more on parental emotions, parental behavior, or a combination of both to better understand the influences on child development. This study could include both parents and analyze their behaviors and emotional responses separately and together. This could be done through having three randomized experimental groups: 1) randomization of parents who only take CCNES, 2) parents who only take some behavior measure like the Multidimensional Assessment of Parenting Scale (MAPS), and 3) parents who take CCNES and MAPS. Children's EF can also be assessed through the BRIEF-P and performance-based tasks. In addition, an intervention that can moderate the potential differences between parenting actions–instead of incorporating a biomarker– could help establish concrete parenting strategies or EF lesson plans that can be implemented to improve the development of child EF and behavior regulation.

One example of an effective intervention is demonstrated in a study by Diamond et al. (2007). The researchers of this study sought to see how a specific preschool program improves cognitive control, also called EF. The idea of the study was to see if preschoolers from low-income families who lived in an urban school district could be taught the EF skills they lacked. Often, teachers receive minimal insight on how to teach or improve their students' EF skills, explicitly self-control and inhibition, because students are expected to already come into school with these skills. Hence, when students do not have these skills and teachers do not understand how to effectively help them develop said skills, these children do not have the opportunity to gain them at any point in their lives. Teachers put them out of class, and students face behavioral consequences for poor self-control. Furthermore, they struggle with behavior problems during their primary and secondary school years, while teachers become discouraged and burnt out (Diamond et al., 2007). The system does not help teachers or students.

Using the Tools of the Mind Program (Tools) based on psychologist Lev Vygotsky's ideas on EF development, the program featured 40 different EF development activities to work on children's inhibition, working memory, and attention. Students were randomly assigned to the Tools curriculum or the school district's version of a Balanced Literacy curriculum (dBL). dBL was based on balanced literacy and included thematic units. Both programs covered the same academic content, but Tools is the only program that promoted EF development. Teachers utilized Tools for 80% of each day to promote the development of their students' EF skills. To evaluate the effectiveness of Tools, students were given two distinct EF tasks– the Dots task and a Flanker task– that they had not been exposed to with their curriculum. In comparison to the Balanced Literacy intervention, Tools students received better scores (Diamond et al., 2007). The daily incorporation of EF activities through play supported the growth of EF skills in students who initially started with poor EF, especially when students are encouraged to engage in such activities together. Thus, the inclusion of interventions, like Tools, can be implemented to improve EF in children who do not have the home environments or have the socioeconomic means to complement the growth of their EF.

Conclusion

In conclusion, this study established further support for the idea that parents, particularly mothers, reactions to their children's negative emotions significantly influence the development of their child's EF and emotion regulation abilities. Negative responses to children's emotions only create a cycle of negative child behavior and poorer EF that continues beyond preschool (Bernier et al., 2010; Oh & Lewis, 2008; Sulik et al., 2015). Positive parenting responses give children the confidence to not shy away from academic challenges or challenging life situations, giving them the skills to thrive for the rest of their lives (Bernier et al., 2012; de Cock et al., 2017; Doan & Wang, 2018; Lins et al., 2022). However, the results of this study are not all-encompassing and give mixed results despite the strength of their association with existing literature. Future research should look into more diverse samples that evaluate multiple aspects of parenting and child development to help children grow positively as individuals.

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