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Executive Function and Parenting Among Latinx Caregivers of Young Children

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Supportive and responsive parenting is vital to the healthy development of young children. Parenting behaviors are determined by many factors, including caregivers' cognitive resources and abilities such as executive functioning (EF). The present study investigated how two core dimensions of EF, working memory and set-shifting abilities, are related to parenting behaviors in a sample of Latinx caregivers of young children experiencing low income. Positive parenting was measured using a multi-method approach including video-coded observations, parent self-report, and evaluation of the home environment. Findings from hierarchical regressions indicated that caregiver working memory, but not set-shifting, predicted positive parenting as measured by this multi-method parenting composite. Regarding negative parenting, poorer working memory predicted more negative parenting behaviors during free play, while poorer setshifting predicted more anger during free play. Intrusiveness during free play was not significantly predicted by EF. Finally, relations were tested between EF and parenting during a task designed to be frustrating for the child. Under these conditions, caregiver set-shifting abilities predicted observed positive parenting behaviors during the caregiver-child interaction while working memory did not. EF was not related to negative parenting behaviors of intrusiveness or anger during the frustration task. These findings provide valuable insight into the role caregiver EF plays in parenting young children under both non-stress and stress conditions. Results from the current study also inform recommendations for parenting interventions and provide important future directions for research exploring the potential impact of caregiver EF on parenting of young children.

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Executive Function and Parenting among Latinx Caregivers of Young Children

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Introduction

Caregivers are incredibly influential in shaping their children's early development. As one of the primary sources of a child's environmental input, caregivers' style and quality of parenting have important impacts. Theoretical models of parenting influences continue to grow in complexity and scope since Baumrind's seminal work (1971) establishing authoritative, authoritarian, and permissive parenting styles. Parenting has long been recognized as a multifaceted construct influenced by a range of contextual factors including parenting stressors, caregiver mental health, family resources, and child characteristics that shape parenting behaviors (e.g., Belsky, 1984; Darling & Steinberg, 1993; Smith, 2010). Abidin's conceptual framework for determinants of parenting (1992) identifies parenting skills and competencies in particular as resources that directly influence parenting behavior.

The present study utilizes Abidin's general framework to test caregiver executive functioning (EF) as one such cognitive resource that is relevant to parenting behaviors. While there is some recent evidence to suggest that caregiver EF plays an important role in parenting school-aged children (as described below; see Deater-Deckard et al., 2010), the current study investigates these questions in a sample of Latinx caregivers of toddlers. Parenting toddlers requires a unique combination of energy, patience, imagination, and behavior management. Therefore, the cognitive flexibility, informational updating, and problem-solving abilities encompassed by EF may be a key element in supportive and responsive parenting. Considering the cognitive load involved in interacting with toddlers while supporting their healthy development, exploring the link between specific EF skills (e.g., shifting, inhibition, working memory) and parenting may provide valuable insight for supporting caregivers of young children.

Executive Functioning in Adults

Research on EF has rapidly expanded over the past few decades across multiple disciplines, including neuroscience, neuropsychology, occupational therapy, and developmental psychology. EF is both a theoretical and clinical construct used to describe a set of higher-order cognitive processes that modulate and integrate lower-order cognitive processes involved in solving novel problems (Gilbert & Burgess, 2008). In general, executive function is an umbrella term that encompasses goal-oriented cognitive processes such as attentional control, flexibility, inhibition, working memory, shifting between tasks, planning, organization, and self-monitoring (Goldstein et al., 2014). Nevertheless, definitions of EF vary widely. Meta-analyses of EF research establish general agreement that it is a multi-dimensional construct characterized by both diversity of individual processes and unity in creating novel problem-solving strategies (Baggetta & Alexander, 2016; Jurado & Rosselli, 2007).

The most frequently utilized model of EF (Baggetta & Alexander, 2016) is based on Miyake's model of EF as an overarching construct comprised of three related but separate subcomponents: updating, set-shifting, and inhibition (Miyake et al., 2000). Evidence for unity and diversity among updating, set-shifting, and inhibition skills is provided by overlapping and individual variance in confirmatory factor analysis of performance on EF laboratory tasks (Friedman et al., 2008). Behavioral genetics supports this model by demonstrating the unity of a "highly heritable common factor" (Friedman et al., 2008) as well as the diversity of genetic factors underlying individual EF subcomponents. The current study works from this model in selecting EF measures and interpreting results from caregiver performance on EF tasks.

Though EF skills are frequently conceptualized as a set of domain-general abilities, neuroimaging has elucidated specific brain regions and neural pathways activated in EF. Neuroimaging findings further support the unity and diversity model by identifying neurologically distinct, but overlapping, processes driven by distinct regions of the pre-frontal cortex (Wagner et al., 2001). Analysis of neural connectivity at rest (i.e., when not engaged in a task), for instance, produced results showing both shared and individual differences in the resting state networks associated with inhibition and shifting processes (Roye et al., 2020). Prominent neurophysiology theories posit that general top-down signals from the prefrontal cortex regulate various neurological processes involved in EF (Koechlin & Summerfield, 2007). Although the top-down regulatory signals are similar in nature, individual EF processes such as working memory and attentional control involve process-specific cortical and subcortical structures and communicate with distinct areas of the prefrontal cortex (Funahashi & Andreau, 2013).

In their analysis of the literature, Gilbert and Burgess (2008) review the theory that the ventrolateral prefrontal cortex is primarily involved in simple tasks and short-term maintenance of information (Badre & Wagner, 2007), while the dorsolateral prefrontal cortex is thought to be more active during complex tasks such as manipulating information and social decision-making (MacPherson et al., 2002). The rostral prefrontal cortex, the largest area of the prefrontal cortex, is theorized to have a cognitive control function (Burgess et al., 2007) required by the most complex of human behavior such as multitasking and meta-cognitive awareness (Gilbert et al., 2006; McCaig et al., 2011). In addition to the prefrontal cortex, the anterior cingulate cortex is thought to be involved in detecting a new problem in the environment and signaling the need for a novel solution from the dorsolateral prefrontal cortex (Shenhav et al., 2016).

Despite advancements in identifying prefrontal foci associated with EF, it is important to emphasize the dynamic, flexible, and interconnected nature of the neural pathways that contribute to EF (Collette et al., 2005; Elliott, 2003). Greater global gray matter volume, for example, is related to better EF abilities (Bettcher, 2016) and demonstrates the tightly integrated neural processes required by these higher-order cognitions. Neuroimaging findings provide evidence that functional directionality and restriction of white matter tracts is linked to EF in younger adults (Smolker et al., 2018), while structural differences in white matter are linked to EF changes in older adults (Hirsiger et al., 2017). Zink et al. (2021) also challenges top-down views of centralized neurological regulation by positing the theory that EF processes are driven by collective activity of a widely distributed underlying brain network. Indeed, the multidimensionality of EF is one of its primary and most empirically recognized characteristics (Baggetta & Alexander, 2016). Accordingly, measurement of EF via neuroimaging and behavioral assessment have demonstrated difficulty in cleanly isolating discrete EF skills.

EF skills are typically evaluated using performance tasks, rating forms, or a combination of the two. Even though EF assessment batteries have become widely used in both research and clinical settings, these measures are not without flaws. Prevailing obstacles faced by EF assessments are difficulties isolating interrelated processes and establishing construct validity of these measures. The former problem is one of "task impurity" whereby performance tasks tend to operate using multiple EF processes as well as processes not associated with EF (Jurado & Rosselli, 2007; Packwood et al., 2011). Creating a task that involves one "pure" measure of working memory, for instance, is virtually impossible to do without also tapping attentional control and spatial abilities, among others. Establishing construct validity for EF tasks is also difficult given the lack of consensus on a specific, measurable definition of the construct itself. As such, studies examining correlations between self-reported EF and task-based performance have mixed results (Dube et al., 2020). Some evidence that adult performance on measures of EF does not correspond to self-report of EF skills (Biederman et al., 2008) suggests that these two methods of assessing EF may in fact measure different underlying constructs (Toplak et al., 2013) and therefore that each provide valuable information in their own right.

These measurement difficulties further contribute to continual development of new performance tasks and a lack of consensus in the field. In fact, Baggetta and Alexander (2016) identified over one hundred different performance tasks used in research studies notwithstanding typical neuropsychological assessment batteries. Some efforts are attempting to clarify this measurement perplexity by creating a standard battery of performance tasks for subcomponents of EF; the NIH built upon Miyake's (2000) model of EF by creating a battery entitled Executive Abilities: Measures and Instruments for Neurobehavioral Evaluation and Research (NIH-EXAMINER; Kramer et al., 2014) that has been tested in normative pediatric and adult samples (e.g., Akshoomoff, 2014; Heaton, et al., 2014; Schreiber et al., 2014). The current study utilizes two EF tasks that are well established in both clinical and research adult populations (Suchy, 2009): the Wisconsin Cart Sorting Test (WCST) as a measure of set-shifting (Jurado & Rosselli, 2007) and the *n*-back as a measure of working memory (Ragland et al., 2002). A spatial version of the *n*-back was also included in the NIH-EXAMINER battery (Kramer et al., 2014).

Poverty, Stress, & Executive Functioning

Caregivers in the present sample were primarily experiencing low income and high levels of stress, which can both have negative impacts on EF, and parenting under these contextual stressors adds additional strain. Socioeconomic status (SES) is positively correlated with numerous EF domains, including memory, processing speed, attentional working memory, and verbal fluency (Arentoft et al., 2015). Indeed, young adults who have experienced homelessness or poverty demonstrate cognitive impairment (Fry et al., 2017). This pattern holds across adulthood, with a strong relation between SES and cognitive function in mid-life (Zhao et al., 2005). In addition to lower SES and income levels, uncertainty amidst adversity also has costly effects on EF. Greater income volatility over one's lifetime and more frequent drops in income are associated with poorer performance on tasks tapping processing speed and EF (Grasset et al., 2019).

There is ample evidence of associations between poverty and executive dysfunction (Dean et al., 2017) with various theories as to the mechanisms underlying this relation. One hypothesis with substantial experimental support is that poverty-related concerns expend one's limited resource of cognitive capacity (Dean et al., 2017; Mani et al., 2013). Experiencing stress, which is more common for people experiencing low income, also contributes to cognitive dysfunction (Girotti et al., 2018). Chronic stress and burnout (Öhman et al., 2007) are consistently related to cognitive fatigue and executive dysfunction in inhibition, attentional control, and EF tasks in daily life (Marin et al., 2011). Specific associations between perceived stress and performance on set-shifting EF tasks (Orem et al., 2008) also emphasize the importance of measuring EF performance in samples experiencing chronic stress. The current sample is primarily low income, with some families experiencing very low income, defined as <50% of the federal poverty line. Further, many are experiencing additional stressors currently and/or have a history of experienced adversity.

Positive Parenting

Parents have enormous influence in their children's lives across multiple settings and domains, which is reflected in parents' prominent role in theories of child development. Bronfenbrenner's ecological systems theory (1979) positions parents in the microsystem bio-ecological domain of the child's ecosystem (e.g., home environment, parenting style), driving the most proximal processes of child development (Krishnan, 2010). Parents also influence the mesosystem (i.e., interactions between microsystems), exosystem (i.e., indirect environments), and macrosystem (i.e., social and cultural values) contexts of child development (Bronfenbrenner, 1986; Neal & Neal, 2013). Behavioral (Skinner, 1938; Watson, 1928) and social learning theories (Bandura, 1977) of development also espouse the impact of caregivers on shaping children's behavior. Parenting encompasses a multitude of skills which include, but are not limited to, helping the child learn new skills, meeting their specific needs, structuring their environments, setting limits, providing warmth and sensitivity in their interactions, stimulating their cognitive growth, and modeling and teaching emotional expression and regulation. Taken together, these parenting skills impact children's behavioral, social-emotional, and cognitive development.

Regarding operationalizing parenting behaviors coded in video observations, positive parenting is a widely used construct and parenting approach that is beneficial for early child development. While the term *positive parenting* can encompass many different aspects of parenting, most definitions of the construct include an element of warmth and responsiveness often combined with a second aspect involving developmentally appropriate limit setting and/or supporting child-led exploration. Early positive parenting definitions include a combination of warmth and discipline (McKee et al., 2007) or of warmth and responsiveness to distress (Davidov & Grusec, 2006). A multi-disciplinary review of the literature asserts a new definition characterizing positive parenting as leading the child by setting limits, caring, providing basic needs and a safe environment, teaching new skills, and communicating effectively (Seay et al., 2014). The current study examined positive parenting as a composite of warmth, responsiveness, positive regard, and parental stimulation of cognitive development.

The link between positive parenting and improved outcomes for children's social, emotional, and behavioral development has been widely investigated (Sanders et al., 2014). Emotionally and behaviorally, greater child-perceived parental warmth is associated with better psychological adjustment (Khaleque, 2013) and lower child aggression (Kawabata et al., 2011). Positive mood, clear communication, and confidence observed in parent-child interactions is associated with greater effortful control for children (Neppl et al., 2020). Positive parenting provides "robust protective effects" for children whether or not they are experiencing adversity (Yamaoka & Bard, 2019). Further, positive parenting can even buffer negative effects of adversity for children who are experiencing early life stress (Greene et al., 2020). Additional evidence for the benefits of positive parenting includes growth in developmental skills and improvement in child behavior that follow changes in parenting towards a more positive style. Positive parenting interventions, for example, have demonstrated improvement in child outcomes in countries across the world at a wide range of income levels (Knerr et al., 2013).

By contrast, intrusive, harsh, or dismissive parenting is linked to poorer child outcomes across development. Harsh parenting (Callahan et al., 2011) and detached parenting (Jones Harden et al., 2014) are associated with greater child problem behaviors, which include both internalizing and externalizing behaviors. Additionally, negative intrusive parenting is linked to disorganized attachment styles of young children (Wang et al., 2015). Intrusive parenting at 14 months of age also has diminishing effects on the developmental trajectory of toddlers' emotion regulation (Mortensen & Barnett, 2019). Although intrusive, harsh, and dismissive parenting can each uniquely impact development, they are closely related and demonstrate common detrimental effects on child outcomes; therefore, they were grouped together in the current study under the broader construct of *negative parenting*.

Measurement of Parenting

The broad scope of parenting engenders a multitude of methodologies for measuring various aspects of parenting. Most methodologies fall into the category of direct observations or questionnaire ratings. While each methodology provides unique information about family functioning (Hayden et al., 1998), no individual methodology can accurately capture the complexity of parenting behaviors (Lindhiem & Shaffer, 2017; Taber, 2010). Therefore, the "gold standard" in parenting research consists of gathering data with multiple methods and from multiple informants (Renk, 2005). In the current study, we examined parenting utilizing three measurement methods: video coding of observed behavior, parent self-report, and home observation. Each of these methodologies boasts strengths and weaknesses in their contributions, which are reviewed here.

Observed Video-Coded Parenting

Video coding of observed behaviors during parent-child interactions is frequently used in measuring parent behavior and interactional dynamics. Observing parent-child interactions provides rich, valuable data on parenting behaviors and insight into the parent-child relationship. Coding videos also allows for second-by-second observations of facial expressions, language, and actions that may be otherwise unavailable (McKee et al., 2013). A major drawback of observing parent-child interactions during a predetermined task is potential lack of external validity (Parent & Forehand, 2017). Although extant literature has demonstrated that the presence of observers does not alter the nature of parent-child interactions (Gardner, 2000), the task parameters and setting (e.g., home, clinic, laboratory) of the observed interaction are important considerations. Other threats to external validity include the limited timescale and constrained conditions of these observations. In many ways, observed parent-child interactions elicit best-case scenario parenting under ideal conditions that may not be representative of typical daily interactions (Gardner, 2000). Importantly, however, parents around the world display a range of parenting behaviors even in these constrained conditions and while being filmed (e.g., Asanjarani, 2021; Mesman, 2021), including in the current study.

Self-Report Questionnaires

In addition to video coding of parent behaviors, questionnaires designed to capture self-reported parenting provide valuable information from the caregiver's perspective. Common domains covered by these self-report questionnaires include parenting stress, daily hassles, sense of competency as a parent, and parent perception of the parent-child relationship. Questionnaires are frequently utilized due to their feasibility, ease of administration and scoring, and low cost (McKee et al., 2013). They also have the potential to capture more stable traits by assessing parenting behaviors over a prolonged, cumulative period as opposed to a 15-minute observed interaction, and caregivers' perceptions of their parenting contribute a unique perspective. Nonetheless, parenting questionnaires often lack well-established psychometric properties and the ability to capture changes in parenting over time (Parent & Forehand, 2017). Other criticisms of parenting questionnaires include difficulty capturing the more dynamic elements of parent-child interactions (Smith, 2011), particularly for young children and the relative objectivity that can be provided by an external rater.

Two frequently implemented self-report questionnaires related to parenting are the Parenting Sense of Competence scale (PSOC; Gibaud-Wallston & Wandersman, 1978) and the Parenting Stress Index (PSI; Abidin, 1990). The three subscales of the PSI (Parental Distress, Difficult Child, and Parent–Child Dysfunctional Interaction) measure different aspects of stress in the parenting relationship. Tested as a three-factor model in an Early Head Start sample, the PSI subscales were examined as follows: Difficult Child was related to parent-reported child oppositionality, Parental Distress was related to low income and self-reported psychological symptoms, and Parent–Child Dysfunctional Interaction was related to low income, psychological symptoms, and parent education (Reitman et al., 2002).

As a measure of parenting competence and self-efficacy, the PSOC is an informative measure about cognitions that may directly impact parenting behaviors. Evaluation of the PSOC with mothers of infants demonstrated that total scores were moderately related to mothers' self-esteem, depressive symptoms, and social support (Karp et al., 2015). Documented associations also link greater PSOC-measured self-efficacy with lower symptoms of maternal depression (Knoche et al., 2007). Regarding parenting behaviors, self-efficacy as measured by the PSOC is related to caregivers' warmth and nurturance (Luengo Kanacri et al., 2021). Taken together, parenting self-efficacy is important for responding confidently and sensitively to a child's needs (Pierce et al., 2010). In turn, parents with low self-efficacy are more likely to engage in aggressive, coercive, or inconsistent responses to difficult child behaviors (Gross et al., 1999).

Observation of the Home Environment

In a child's home environment, structure, routine, and quality play a vital role in supporting development. Quality of the home environment is associated with better child outcomes such as overall cognitive and developmental scores (Knauer et al., 2019). The quality of the home environment also predicts children's academic outcomes in math and reading (e.g., Evans & Field, 2020; Sénéchal & LeFevre, 2014) as well as teacher-child closeness (Jerome et al., 2009). When examining the impact of the income gap on differences in children's social-emotional development, the family routines, home learning activities, and psychosocial quality of the home environment were more influential than children's cognitive scores in explaining this relation (Kelly et al., 2011).

Findings linking the home environment to specific parenting behaviors provide support for using experimenter-rated assessments such as the Home Observation for Measurement of the Environment (HOME; Caldwell & Bradley, 1984) as a global indicator of parenting (e.g., Kendrick et al., 2000). For example, chaos in the home environment as measured by the Chaos, Hubbub, and Order Scale (CHAOS; Matheny, et al., 1995) is inversely related to parenting warmth (Coldwell et al., 2006). Disorganization in the home is also associated with less sensitive and more intrusive parenting for both mothers and fathers (Zvara et al., 2020). Benefits of the HOME assessment include the comprehensiveness of its domains, relative ease of administration, and sensitivity to parenting style and support (Bradley & Corwyn, 2005). Another strength of the HOME measure is that it is inherently a multi-informant approach by utilizing both observational items as well as caregiver-report items. In terms of drawbacks, the HOME inventory may not be as sensitive in capturing variation among normative parenting practices (Smith, 2011). In addition, it is important to keep in mind that the HOME inventory is consistently related to family socioeconomic status (SES; Bradley & Corwyn, 2005).

Poverty, Stress, & Parenting

Effects of poverty and SES on parenting are well-established. Many mechanisms of this relation have been investigated, including environmental instability, elevated chronic distress, caregiver mental health, social support, and family conflict (Kaiser & Delaney, 1996). Decades of research demonstrate that parents experiencing poverty are less likely to exhibit consistent, supportive parenting (Sampson & Laub, 1994) and more likely to engage in parenting characterized by less warmth and more harshness (Pinderhughes et al., 2001). Neighborhood and family poverty further contribute to poorer physical environment as measured by the HOME scale (Klebanov et al., 1994).

Several aspects of stress such as those experienced by families in the current sample also contribute uniquely to parenting behaviors. Caregiver stress is a key contextual factor influencing self-report of parenting behaviors and observed parental responsiveness, harsh discipline, warmth, and permissiveness (Bornstein et al., 2007). When examining varying chronologies of stress, cumulative parenting stress predicts less positive affect while the stress of daily hassles predicts less dyadic pleasure in parent-child interactions (Crnic et al., 2005). Stress, poverty, and SES are important points to consider when interpreting results related to parenting outcomes.

Cultural Considerations

It is sometimes assumed that positive and negative parenting have invariant effects on child outcomes across racial and ethnic groups. While supportive parenting is related to better child outcomes on average, regardless of the caregiver's racial or ethnic identity (Brady-Smith et al., 2013), overreliance on WEIRD (Western, Educated, Industrialized, Rich, and Democratic; Henrich et al., 2010) samples in research has hindered a more nuanced understanding of parenting practices that may be uniquely beneficial in certain cultures. When parenting effects on children are investigated in more diverse, non-white samples of families, some evidence suggests that while broad constructs have similarly salutary or compromising impacts, there are subtle nuances in the effect of parenting styles on child outcomes among specific racial and ethnic groups.

For example, directive, child-oriented parenting may be related to better pre-academic readiness and language outcomes among young African American children (Dyer et al., 2014). Potentially negative effects of directiveness are counterbalanced by the positive effects of sensitivity for African American children, whose caregivers are more likely to parent with high levels of both qualities (Ispa et al., 2015). For Latinx children, the negative impact of authoritarian parenting characterized by high demand and low responsiveness is weaker than for non-Latinx white children (Pinquart & Kauser, 2018). Positive parenting in Latinx immigrant families is also linked to greater child social self-efficacy (Leidy et al., 2010). Although many caregiving similarities exist across cultures (Bornstein, 2012), the specificity of racially and ethnically diverse parenting behaviors and the contexts in which parenting occurs is important to consider when studying parenting behaviors. In the current study, the measures selected to measure positive and negative aspects of parenting have been validated in Latinx samples and capture aspects of positive parenting that are evident across cultures.

Executive Functioning and Parenting

Parenting is a complex task requiring many of the higher-order processes involved in executive functions. Caregivers have finite resources to draw from, and it is plausible that the ability to shift between tasks, inhibit impulses, and hold multiple goals in mind are valuable skills for supporting better child outcomes. Balancing the simultaneous goals of playing with one's infant or toddler while providing positive praise and reinforcement, managing difficult behaviors, teaching new skills, and setting appropriate limits may be critically supported by strong EF skills. Cognitive skills also allow parents to problem-solve effectively in the midst of constantly evolving demands of their child's development (Azar et al., 2008).

The current study investigated the ways in which EF skills and parenting abilities are interconnected. Examining the relation between caregiver EF and parenting behaviors is a newer area of research with relatively limited findings (Distefano et al., 2018; Monn et al., 2017). Existing literature nevertheless suggests that caregivers with lower EF abilities are more likely to engage in negative, harsh parenting practices (Deater-Deckard et al., 2012) and less likely to demonstrate positive parenting behaviors (Crandall et al., 2018). For example, maternal EF was positively related to sensitive parenting (Crandall et al., 2018), parental scaffolding (Mazursky-Horowitz et al., 2018), and positive parenting practices in a high-risk sample of caregivers (Monn et al., 2017). Overall, better performance on tests of executive function appears to support warmer, sensitive, and more supportive behaviors that in turn positively impact children's developmental outcomes.

When examining results of studies investigating EF and parenting behaviors assessed by direct observation of parent-child interaction, it is important to take the environment and context of the interaction into account. Many of these studies coded parent behavior during a potentially frustrating task with high demands such as a teaching, problem-solving, or frustration task (Deater-Deckard et al., 2010; Monn et al., 2017; Sturge-Apple et al., 2017). Relatively fewer studies have compared parenting across tasks with differing demands such as a free play task and challenge task; those that have demonstrated task-specific variation in parenting behaviors. For example, parents demonstrated more overcontrol, anxious behavior, and criticism during a structured task than an unstructured one (Ginsburg et al., 2006). Another study revealed differences in parents' control behaviors but not in warmth between different types of tasks (Caron et al., 2006). Further, no previous studies to our knowledge have examined this difference in the context of parent EF. The present study offers a unique perspective to this growing literature by testing parenting in multiple contexts including a free play interaction and frustration task. Additionally, though select studies have examined EF and parenting in racially diverse, high-risk populations (e.g., Monn et al., 2017), the current sample of low-income, Latinx caregivers provides valuable insight into the experience of ethnically diverse families who are underrepresented in research.

Examining positive parenting among Latinx families experiencing low income is particularly important due to the unique stressors facing Latinx caregivers, especially for monolingual Spanish-speaking families and immigrants. Immigrant families experience a multitude of acculturative stressors that impact parent mental health and wellbeing (Miller & Csizmadia, 2022), which in turn impacts parenting and downstream child outcomes (Calzada et al., 2019). The current study aims to shed light on the strengths of Latinx caregivers in parenting their young children. Additionally, literature on EF and parenting is nascent across all populations, including Latinx families. Exploring the roles of EF and parenting among Latinx families can provide beneficial suggestions for ways to support these families who are already facing significant cultural and socioeconomic stressors.

The methodology used in the current study is similar to methods used in previous studies of EF and parenting. To measure caregiver EF, most studies use performance tasks in the areas of working memory, shifting, and inhibition (Crandall et al., 2015). Parenting behaviors have been measured via self-report (Crandall et al., 2018) and/or video-coding of positive and negative parenting behaviors during parent-child interaction. This established methodology offers support for the current analysis to contribute directly to the literature through meaningful exploratory analyses.

The Current Study

Aim 1

The first aim of the study examined the association between caregiver EF and parenting quality triangulated using three different methodologies: 1) video coded ratings of positive (e.g., sensitivity, positive regard) and negative (e.g., intrusiveness, detachment, negative regard) parenting behaviors during a semi-structured free play task, 2) parent self-report on questionnaires measuring parent-child dysfunctional interactions and sense of competency in being a parent, and 3) observational ratings of the quality of the home environment in supporting child development. To examine this relation, composite variables were created and tested for associations between caregiver EF and overall parenting quality.

Given the fast-paced and ever-changing nature of interacting with infants and toddlers while also handling adult work and personal demands, higher-order planning skills of working memory and set-shifting may be important foundational skills providing caregivers with bandwidth to scaffold their child's behavior and emotion regulation while also creating a structured and supportive environment for learning. Therefore, it was hypothesized that better EF would be directly related to increased use of positive parenting strategies and decreased use of negative parenting strategies during free play.

One limitation of the present investigation is the cross-sectional nature of the data. All measures were administered at baseline home visits before intervention as part of a randomized control trial. Since the data utilized is not longitudinal, we cannot conclude directionality of our findings. Therefore, the purpose of this paper is to provide valuable exploratory insight from a culturally diverse sample of Latinx caregivers and toddlers, adding to limited existing research involving parenting and EF. As such, post-hoc analyses were also conducted to explore further links between EF and individual components of the parenting composite.

Aim 2

The second aim of the study explored whether caregiver EF is differentially related to parenting during a low-stress free play interaction versus during a high-stress frustration task. The unique design of this study allowed for comparison of parenting behaviors under different levels of stress with individual task demands. With this background in mind, it was hypothesized that caregiver EF would be more likely to predict positive and negative parent behaviors during the frustration task than during the free play task given the additional cognitive and emotion regulation demands placed on parents when their child is stressed.

Method

Participants

Families were recruited from Early Head Start childcare centers in a western metro area as part of a larger study examining young children's experiences of early life stress. Eligible families were English or Spanish speaking with a child between six months and four years of age at the start of the study. The final sample of caregivers enrolled in the study was 202. The current sample was comprised of 133 caregivers who completed at least one executive functioning task. The sample was 99.2% female (*n* = 132) and 0.8% male (*n* = 1). Caregivers' ages ranged from 18 to 49 years of age (M_{age} = 31.6 years, SD = 6.5) with 133 target children between 6 and 45 months of age (M_{age} = 25.1 months, SD = 9.5).

Participants were oversampled for low income, with 66.9% of families in the study living at or below the federal poverty line. Based on parent-reported ethnicity, 78.2% of caregivers (*n* = 104) self-identified as Hispanic or Latinx. In the current sample of caregivers, 62.4% (*n* = 83) were born outside of the U.S. in primarily Latin American countries. Specifically, 77 caregivers were born in Mexico, two in Guatemala, one in Honduras, one in El Salvador, and one in Peru. One caregiver was born in Bulgaria. Self-reported race of caregivers in the sample was reported as 68.4% Latinx, 14.3% African-American/Black, 8.3% white non-Latinx, 6.8% multiracial/biracial, 1.6% Asian or Pacific Islander, and 0.8% Native American. Regarding caregiver education, 13.6%

ended formal education before high school, 16.7% attended some high school, 28.0% graduated high school or earned a GED, 25.8% attended some college or technical school, 10.6% graduated from a four-year college, and 5.3% completed at least some graduate education (see Table 1).

Table 1: Caregiver Demographic Characteristics

Characteristics	Sample Demographics *n* (%)
Caregiver Age	
18-24	21 (15.8)
25-34	67 (50.4)
35-44	42 (31.6)
45+	3 (2.3)
Ethnicity	
Hispanic/Latinx	104 (78.2)
Not Hispanic/Latinx	29 (21.8)
Race/Ethnicity	
Latinx	91 (68.4)
Black/African American	19 (14.3)
White	11 (8.3)
Biracial/Multiracial	9 (6.8)
Asian/Pacific Islander	2 (1.6)
Native American	1 (0.8)
Nativity	
Born in the U.S.	50 (37.6)
Born outside the U.S.	83 (62.4)
Poverty Level (≤ % federal poverty line)	
50%	35 (26.9)
100%	52 (40.0)
150%	22 (16.9)
200%	11 (8.5)
250%	5 (3.8)
300%	5 (3.8)
Education Level	
Less than high school	18 (13.6)
Some high school	22 (16.7)
High school graduate or GED	37 (28.0)

Some college or technical school	34 (25.8)
Four-year college graduate	14 (10.6)
Some graduate or graduate degree	7 (5.3)

Procedure

Measures were administered during home visits by bicultural, bilingual members of the research team in the family's preferred language. Questionnaires were administered verbally with a written copy of the forms provided to caregivers during the visit. Spanish versions of questionnaires were either previously translated and established as reliable (e.g., PSI-SF, PSOC, CESD) or translated and back-translated by native Spanish speakers on the research team (e.g., language use survey). Caregiver EF was measured using two computerized tasks completed on a provided research laptop during the same visit. Instructions for both tasks were given in English and/or Spanish with practice trials to allow for additional instruction and clarification, particularly in consideration of the wide range of caregiver education.

Measures

Caregiver Executive Functioning

N-Back Task

The first EF task completed was a computerized *n*-back task, which primarily assesses working memory (Owen et al., 2005; Redick & Lindsey, 2013). Although frequently used in fMRI studies, neuropsychological studies have also identified concurrent validity of *n*-back and working memory tasks in clinical settings (Jacola et al., 2014). In the computerized administration of the *n*-back, four trial types were presented three times each throughout the task: *0*-back, *1*-back, *2*-back, and *3*-back. Each stimulus consisted of a single letter presented for 500 milliseconds with 2500 milliseconds of a blank screen between each letter.

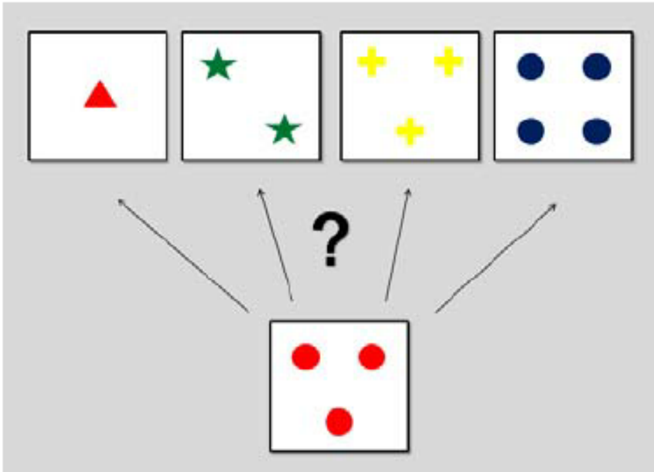
Caregivers were instructed to press the space bar when the letter shown matched the target letter (*0*-back trials) or the letter shown *n* slides back (all other trials). For example, in the *2*-back trials, caregivers were instructed to respond by pressing the space bar if the letter shown was identical to the letter presented two trials back. A member of the research team explained the four *n*-back conditions to caregivers using a practice sheet to illustrate the process. The researcher also answered caregivers' questions until they felt they understood the task. Each caregiver then completed one practice round of each *n*-back condition before completing the scored task. Participants were instructed to respond as quickly and as accurately as possible.

The *n*-back task was scored for performance accuracy where the false alarm rate (button press when the target did not match) was subtracted from the hit rate to reflect the percentage of correct hits and misses (Snodgrass & Corwin, 1988). In the *n*-back task, all caregivers were presented with 201 trials. Variables of interest were percentage of trials correct (correct number of trials divided by total trials) and ratio of hits (correctly pressing the space bar) to false alarms (incorrectly pressing the space bar). Total number of false alarms and total number of misses (neglecting to press the space bar when required) were also examined.

Wisconsin Card Sorting Test

Caregivers completed the Wisconsin Card Sorting Test (WCST; Heaton et al., 1993), a widely-used task requiring EF skills such as set-shifting, flexibility, inhibition, and abstract reasoning (Kolakowsky-Hayner, 2011; Robinson et al., 1980). The WCST can be administered using physical stimulus cards or in a computerized format; the latter was used in the current study. In the task, the computer screen showed four stimulus cards at a time differing by the categories of shape, color, and/or number as shown in Figure 1. A member of the research team instructed caregivers to sort a new card into one of four piles using the keypad; the word "right" would appears on the screen for a correctly sorted card or the word "wrong" for an incorrectly sorted card. Caregivers were not informed of the possible sorting principles or that the sorting principle would shift throughout the task. The task continued until all six categories (color, form, number, color, form, number) were achieved or until all 128 cards were administered.

Figure 1: Representation of the Wisconsin Card Sorting Test



Note. From "Reactive Task-Set Switching Ability, Not Working Memory Capacity, Predicts Change Blindness Sensitivity" by R .J. Youmans, I. J. Figueroa, and O. Kramarova, 2011, *Proceedings of the Human Factors and Ergonomics Society Annual Meeting, 55*(1), p. 915. Copyright 2011 by Human Factors and Ergonomics Society, Inc.

The computerized WCST was scored based on a modified version of the original version with physical stimuli. In the original WCST version, the sorting principle shifts after participants make 10 correct responses in a row; whereas, in the computerized WCST, the principle shifted after participants selected 4 correct responses in a row. We used the following performance indices adapted from the original WCST manual (Heaton et. al 1993) based on performance on the computerized WCST: 1) Total number of trials completed, 2) Total number of categories completed, 3) Number of trials executed in order to successfully complete the first category, 4) Percentage of trials correct to total number of trials, 5) Perseverative errors as a percentage of the total number of trials. Additionally, two performance indices were used to evaluate participants' perseverance and learning strategies (see Chou et al., 2010): Learning to Learn (average difference in percent errors between successive categories) and Failure to Maintain Set (number of times participant makes 2 or 3 correct responses in a row but then answers the 4th item incorrectly).

Parenting

Observed Video-Coded Parenting

Three-Bag Assessment Coding

Caregivers participated in a semi-structured videotaped interaction with their infant or toddler in the home visit setting, utilizing a popup tent to standardize the spacing and context across home environments. The interaction lasted for approximately 10 minutes and was adapted from the Early Head Start Research and Evaluation Project Three-Bag Assessment (NICHD Early Child Care Research Network, 1999). During the first four minutes, parents were given an age-appropriate picture book to read with their child. Next, parents were provided with two bags of age-appropriate toys and were instructed to play as they normally would with their child. This six-minute free play interaction was video-taped using two camcorders; one to capture the broader interaction and the other zoomed in on the child's face as much as possible. Videos of the 10-minute interaction were subsequently transcribed, and Spanish videos were translated into English and transcribed.

Free play videos of parent-child dyads were rated by coders trained in the Three-Bag Assessment parent behavior scales (manual created by Ware et al., 2000). Coders were trained under the direction of a centralized coding team headed by Dr. Mills-Koonce that specialized in the Three-Bag Assessment coding scheme. Parenting behaviors were coded using a 5-point rating scale along seven dimensions: sensitivity, cognitive stimulation, animation, positive regard for the child, intrusiveness, detachment, and negative regard for the child. For analyses, a composite of positive parenting behaviors was calculated by averaging scores from the sensitivity, positive regard for the child, animation, and cognitive stimulation subscales (see Brown et al., 2020). A similar composite of negative parenting behaviors was calculated by averaging scores from the intrusiveness, detachment, and negative regard for the child subscales. The continuous composite variables (ranging from 1 to 5) for positive and negative parenting were utilized in analyses.

The Three-Bag Assessment and seven-dimension free play video coding scores have been previously established (Gagne et al., 2011; NICHD Early Child Care Research

Network, 1999) and demonstrate good reliability, α = .83. Interrater reliability was calculated for a random subset of double-coded pre- and post-videos (*n* = 24, ICC = .57–.88), though only pre-videos were used for the present analyses. The average intraclass correlation (ICC) between raters was .74 across subscales (Brown et al., 2020).

LAB Tab Free Play and Frustration Task Coding

In addition to the 10-minute semi-structured parent-child interaction described above, caregivers participated in a stress paradigm adapted from the Laboratory Temperament Assessment Battery (LAB Tab) created by Goldsmith and Rothbard (1988). The stress paradigm included a five-minute frustration task where children were instructed to open a clear, locked box with a toy inside. Videos were subsequently transcribed, and the majority of Spanish videos were translated into English. Spanish videos that were not translated due to research staff constraints were coded by a bilingual coder. The author participated in multiple virtual training sessions with an identified LAB Tab trainer during which reliability videos were reviewed and discussed in detail. The author's reliability videos were then compared to multiple gold-standard coders and determined to pass reliability checks. In turn, the author trained one additional coder in the LAB Tab coding scheme to become the primary coder. Training involved regular meetings to review videos as well as a randomly selected subset consisting of 20% (*n* = 37) of overall videos which were coded by both coders for reliability. Although coders analyzed videos from multiple timepoints as part of a larger study, coders were blinded to the video timepoint and only videos from baseline home visits were used in the present analyses. Inter-rater reliability was calculated using ICC which demonstrated excellent inter-rater reliability, α = .92, across coder ratings for all tasks.

Trained coders used the LAB Tab behavioral coding scheme to identify child and parent affect, actions, and verbalizations, as well as qualitative ratings of warmth, responsiveness, and rapport between caregiver and child. Parenting codes were assigned for each individual task, allowing for direct comparison between the free play interaction and frustration task coder ratings. All codes were rated on a Likert scale from 1 to 5, with the exception of intrusiveness which was rated from 0 to 2, such that 5 indicated more of the observed behavior and 1 indicated less of the observed behavior. Specific anchors were identified for each rating and were unique to individual items. See Table 2 for means and standard deviations of applicable parenting coder ratings by task type. Selection of specific codes is explained in further detail in the results section.

Table 2: Mean and Standard Deviation for LAB Tab Parenting Coder Ratings

Coder Rating	Free Play *M (SD)*	Frustration Task *M (SD)*
Skill responding to child's bids for reassurance	4.1 (0.9)	3.8 (1.0)
Positive affect displayed by caregiver	3.3 (1.0)	2.8 (0.9)
Sensitive and responsive to child's needs and cues	2.9 (0.8)	2.8 (0.8)
Overall affect toward child	4.1 (0.7)	3.8 (0.7)
Ability to structure environment or set limits	3.3 (0.7)	3.3 (0.9)
Aided, encouraged, and/or eased child's participation	3.7 (0.8)	3.7 (0.7)
Overall quality of caregiver-child relationship	3.9 (0.7)	3.7 (0.7)
Angry affect displayed by caregiver	1.1 (0.3)	1.2 (0.4)
Intrusiveness with the child	0.8 (0.7)	0.6 (0.7)

Self-Report Questionnaires

Parent-Child Dysfunctional Interaction

Parents completed the 36-item Parenting Stress Index Short Form (PSI-SF; Abidin, 1990) to assess perceptions of their relationship with their child. The PSI requires parents to indicate their agreement with a series of statements about their parenting (1 = *Strongly Disagree* to 5 = *Strongly Agree*). The parent-child dysfunctional interaction subscale was used for analyses in the current study. Example items from this subscale include: *Most times I feel that my child does not like me and does not want to be close to me* and *This child smiles at me much less than I expected.* The English PSI-SF has demonstrated good internal consistency in a low-income sample (Whiteside-Mansell et al., 2007) with Cronbach's alpha for individual subscales ranging from α = .76 to α = .83. Prior research with Latinx immigrant mothers demonstrated strong internal consistency and discriminant validity for the Spanish-PSI with Cronbach's alpha for individual domains ranging from α = .88 to α = .94 (Solis & Abidin, 1991). Reliability was good in the current sample for the total PSI scale (α = .87). Cronbach's alpha ranged from α =. 81 to α = .87 for individual subscales, with good reliability for the parent-child dysfunctional interaction subscale (α = .87).

Parenting Sense of Competence

Parents completed the competence subscale from the Parenting Sense of Competence Scale (PSOC; Gibaud-Wallston & Wandersman, 1978; Johnston & Mash, 1989) to assess domain-general parenting self-efficacy. Parenting self-efficacy focuses on how parents feel in their parenting role and treats parenting self-efficacy as distinct from other forms of self-efficacy (Coleman & Karraker, 2003; Jones & Prinz, 2005). The competence scale includes 8 items and asks parents to rate their agreement with a series of statements (1 = *Strongly Disagree* to 6 = *Strongly Agree*), with higher scores indicating stronger parenting self-efficacy. Example items include: *If anyone can find the answer to what is troubling my child I am the one,* and *I honestly believe I have all the skills necessary to be a good parent to my child.* The PSOC has demonstrated strong reliability among caregivers of toddlers ($\alpha = .81$; Coleman & Karraker, 2003). The Spanish translation of the PSOC has shown good internal consistency ($\alpha = .80$) and strong concurrent and convergent validity with a sample of Spanish-speaking Latinx children (Haack et al., 2011). In the current sample of families, reliability was good ($\alpha = .84$).

Observation of Home Environment

The Home Observation for Measurement of the Environment Infant/Toddler Version (HOME; Caldwell & Bradley, 1984) was used to measure primary caregivers' parenting behaviors in the home. Raters were trained home visit experimenters who completed the measure over approximately two hours during a single home visit. Raters endorsed items based on observed behaviors and by asking caregivers whether certain conditions were characteristic of the typical home environment or if events were characteristic of their typical routine.

The HOME includes 45 observation and interview items that comprise 6 subscales: responsivity, acceptance, organization, learning, involvement, and variety. The 11-item responsivity subscale, which examines the caregiver's verbal and emotional responsiveness to their child, was used as a measure of observed maternal sensitivity (e.g., Whittaker et al., 2011). The 8-item acceptance subscale measures the caregiver's acceptance of the child's behaviors and the absence of undue restriction or punishment (Bradley et al., 2003). The 6-item organization subscale, 9-item learning materials subscale, and 5-item variety scale are largely based on home visit observations. The 6-item involvement subscale was also used. Example items include: *Parent structures child's play periods* and *Parent talks to child while doing household work.* The HOME total score has shown adequate reliability (α = .77) as have the individual subscales (α = .68-.78) in the Early Head Start Research and Evaluation Project (NICHD Early Child Care Research Network, 2002). HOME total scores in the current sample demonstrate good reliability (α = .81-.86).

Covariates

Caregiver Age

There is a significant body of research establishing age-related differences in adult EF (Hull et al., 2008). With caregivers in the current sample ranging from 19 to 49 years of age, caregiver age was tested as a covariate in hierarchical regression analyses. Age effects have been demonstrated for shifting, updating, inhibition, and prospective memory for young adults (18 to 39 years old) versus older adults (57 to 77 years old), though working memory did not demonstrate the same decline (Schnitzspahn et al., 2013). Maternal age is also related to parenting style, whereby older mothers are more likely to engage in positive parenting practices (Fox et al., 1995), nurturance, and establishment of routines (Arnott & Brown, 2013). As such, caregiver age was tested as a covariate in the current study.

Caregiver Depression

Any potential link between parent EF skills and positive parenting may be impacted by parental factors that allow or constrain caregivers' ability to access these executive functions. In other words, even though a caregiver may have the foundational cognitive capacity for strong EF skills, they may have difficulty implementing or applying these skills in the context of parenting their children. One proposed barrier to performing at one's ideal parenting capacity is caregiver depression. Overall, maternal depression is more strongly linked with an increase in negative parenting behaviors than a decrease in positive, warm parenting approaches (Lovejoy et al., 2000). For instance, depression significantly impacts parenting behaviors such as reduction in expressed emotion (Gravener et al., 2012). Caregivers endorsing depression engage in more negative parenting behaviors such as neglect and psychological aggression, as well as less engagement with their children (Turney, 2011). In a longitudinal study, higher maternal depressive symptoms were associated with both overreactive parenting at three years of age and, at six years of age, more overreactive parenting behaviors and less warmth (Errázuriz Arellano et al., 2012). Overall, depression is an increasingly common experience among mothers and caregivers more generally (Goodman & Garber, 2017). It is important to better understand these interacting caregiver experiences so we can support them in parenting their child utilizing all of the skills they already possess.

Cognitively, extant literature establishes that adults with depression demonstrate neuropsychological impairments (Porter et al., 2007). Specific impairments in the domain of EF are theorized to drive these cognitive differences with evidence for poorer performance on tasks measuring inhibition, switching, category fluency, working memory, planning, and initiation (Austin et al., 2001; Hammar et al., 2011). Executive dysfunction among depressed adults is well-documented based on task performance (Alves et al., 2014; DeBattista, 2005; Marazziti et al., 2010), and depression severity is also correlated with performance on EF tasks such as the WCST (Merriam et al., 1999). Experiencing depressive symptoms, therefore, can result in caregivers experiencing less emotionally availability, less responsivity and warmth toward their child, or temporary cognitive impairment that impedes their ability to parent as they typically might. Given robust evidence for the connection between depression and executive dysfunction, caregiver depression was tested as a covariate in the current study.

Caregivers were asked to complete the 20-item Center for Epidemiological Studies Depression Scale (CESD; Radloff, 1977). CESD items require respondents to report on the frequency of experiencing depressive symptoms over the past week on a four-point scale, with 0 indicating *rarely or none of the time* (less than one day over the past week) to 3 indicating *most or all of the time* (five to seven days in the past week). The total symptom score was used. Among caregivers in the current study, 26.2% (n = 27) endorsed depression symptoms at or above the clinically suggested cutoff of 16 symptoms (items rated at a frequency of 2 or 3). Mean total symptom score was 10.9 with a standard deviation of 9.4. The CESD has proved reliable in community samples

(Radloff, 1977) and with Mexican American populations (α = .85; Corona et al., 2012). The Spanish translation of the CESD showed good reliability when used with a similar Head Start sample of 310 families by our team (α = .80). Reliability in the present sample was good (α = .88).

Language Preference and Use

Overall, 61.7% of screening visits (*n* = 82) were conducted primarily in Spanish and 38.3% of visits (*n* = 51) were conducted primarily in English. Spanish-speaking caregivers completed an additional measure of preferred language usage in various settings based on the measure created by Vega (Vega & Gil, 1998) that has been previously validated as a proxy for acculturation (Turner et al., 2006). Using this scale, caregivers were asked to rate their proportion of Spanish versus English usage on a scale from *1* (Spanish all the time) to *5* (English all the time) for the language in which they consume media, speak to their family, converse with their friends, and use at work. These four subscales were averaged to create a total language score (see Hurwich-Reiss & Watamura, 2019). Within the current sample, reliability of these five questions was excellent (α = .97). Caregivers were also asked what language they prefer to speak in general.

Linguistic use has long been recognized as a measure of acculturation for Latinx individuals (Turner et al., 2006). Relations between adult EF and acculturation status as measured by language proficiency have been documented for performance on non-verbal tests of processing speed and set-shifting (Razani et al., 2007). Furthermore, acculturation profiles of parenting indicate associations between acculturation and positive parenting among Latinx families (Williams et al., 2017). Authoritarian and authoritative parenting styles are also linked to acculturation status through cultural values among Mexican and Dominican mothers (Calzada et al., 2012). Therefore, language use as a proxy for acculturation was included as a potential covariate in regression analyses.

Poverty Category

In the current study, poverty category was used as a measure of socioeconomic risk and included in analyses as a potential covariate. Poverty category was calculated using annual U.S. Census Bureau poverty thresholds (United States Census Bureau, 2022). Poverty thresholds were determined by the number of adults and children living in the household as well as the year in which income was reported. Families living at or below (i.e., $\leq$ 100%) the federal poverty line (FPL) are considered to be living in poverty. While poverty thresholds are widely utilized in research on family income (Roosa et al., 2005), they can also be considered an oversimplified measure of economic hardship experienced by families. As such, the current study also implemented additional, more subjective measures of economic hardship, food insecurity, and material needs. However, exploratory analyses demonstrated that poverty categories were most strongly related to variables of interest in the current analyses. Considered together, poverty categories were therefore deemed most appropriate to measure socioeconomic risk.

Poverty categories were calculated using caregiver reported annual household income divided by the FPL. Categories were as follows: 50% FPL or lower, 50-100% FPL, 100-150% FPL, 150-200% FPL, 200-250% FPL, and 250-300% FPL. Categories were numbered such that a higher poverty category indicated greater distance from the

FPL, or higher income and less socioeconomic risk. As previously stated, 66.9% of families in the current study were living at or below the FPL. See Table 1 for more detailed sample demographics by poverty category.

Results

Composite Variables

Analyses were conducted using the Statistical Package for Social Sciences, Version 28 (SPSS; Nie et al., 1975). Preliminary analyses were conducted to identify the appropriateness of planned composite variables. Subsequently, composite variables were created by norming each of the individual components and then creating an average of these components. Cronbach's alpha was calculated at each step to assess internal reliability of the composite as well as effects on Cronbach's alpha if individual items were dropped.

Executive Functioning Composite

N-Back Task Performance

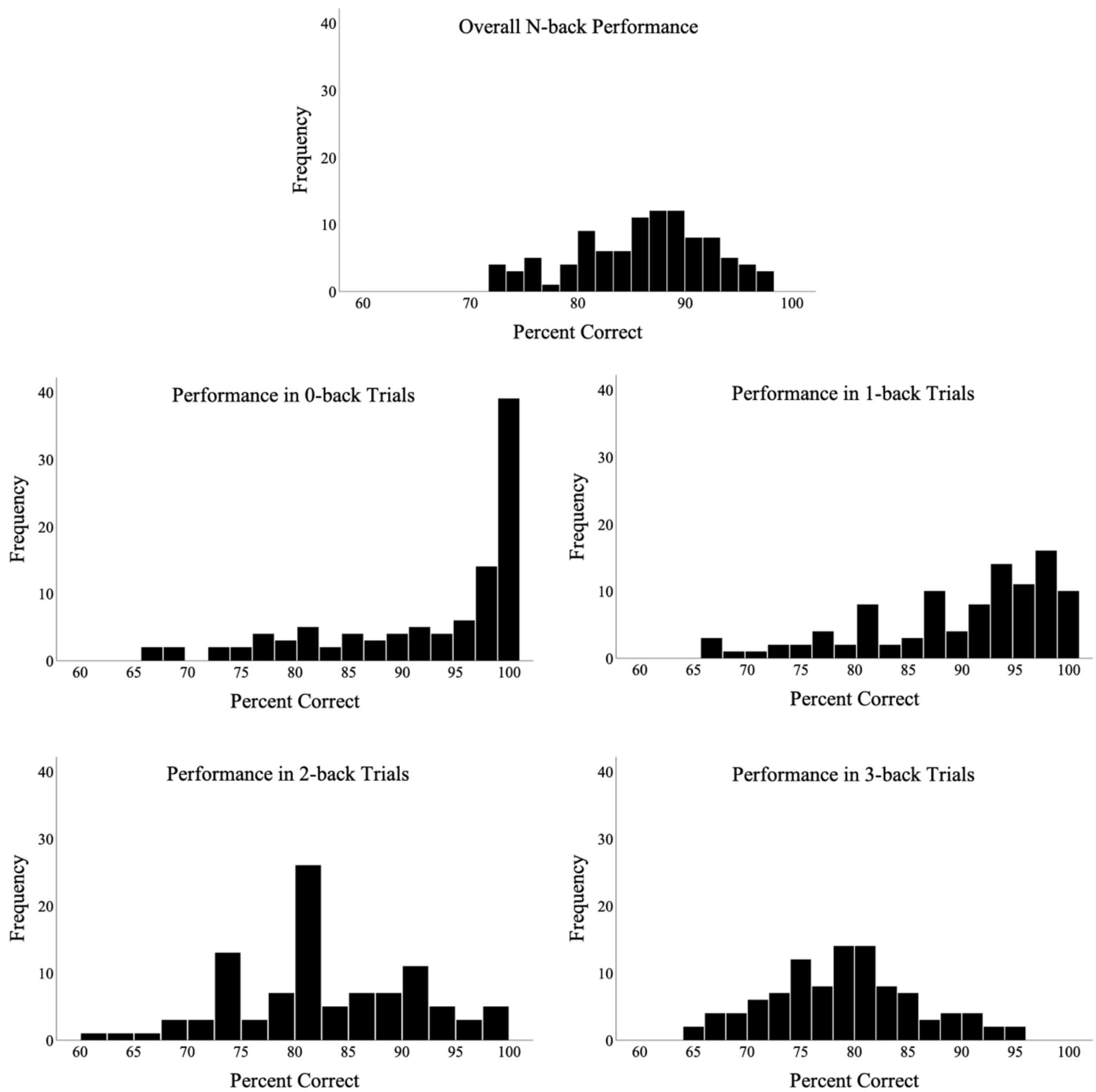
Overall, 101 participants completed the computerized *n*-back task. Variables of interest were percentage of trials correct, ratio of hits to false alarms, total number of false alarms, and total number of misses. Reflecting overall performance, mean percentage of trials correct was 85.97 (SD = 6.32). Mean ratio of hits (correctly pressing the space bar) to false alarms (incorrectly pressing the space bar) was 6.42 (SD = 6.93). Mean total false alarms was 10.14 (SD = 7.32), while mean total misses (neglecting to press the space bar when required) was 17.73 (SD = 10.71). Although each variable provided unique information about performance on the *n*-back working memory task, only percentage of trials correct was deemed to be relevant to the study hypotheses. Overall accuracy is the most commonly utilized measure of *n*-back performance (Redick & Lindsey, 2013) in working memory research. Furthermore, other variables derived from *n*-back performance (e.g., ratio of hits to false alarms, false alarms, misses) were less conceptually relevant as EF skills that would be expected to influence parenting.

Performance was also evaluated by trial type. The four trials types were *0*-back, *1*-back, *2*-back, and *3*-back. Mean percent correct was 92.35 (*SD* = 9.55) for *0*-back trials, 89.85 (*SD* = 8.84) for *1*-back trials, 82.61 (*SD* = 8.40) for *2*-back trials, and 79.15 (*SD* = 7.01) for *3*-back trials. Histograms for each type (Figure 2) revealed trends toward ceiling effects for the *0*-back and *1*-back trials but not for the *2*-back and *3*-back trials. However, all trial types combined into overall performance indicated normal distribution and adequate variability (see Figure 2). Therefore, the overall performance variable was used for all analyses.

Wisconsin Card Sorting Test (WCST) Performance

Overall, 127 participants completed the computerized WCST task. Regarding performance, the mean total number of trials completed out of 128 possible trials was 103.65 (*SD* = 29.94) and the mean number of categories completed out of 6 possible categories was 4.52 (*SD* = 1.78). Mean number of trials executed in order to successfully complete the first category was 22.76 (*SD* = 28.06). Mean percentage of trials correct was 41.33 (*SD* = 12.62). For perseverative errors as a percentage of the total number of trials, the mean across participants was 6.64 (*SD* = 5.45). Two performance indexes were also examined. Mean learning to learn error change score (average difference in percent error

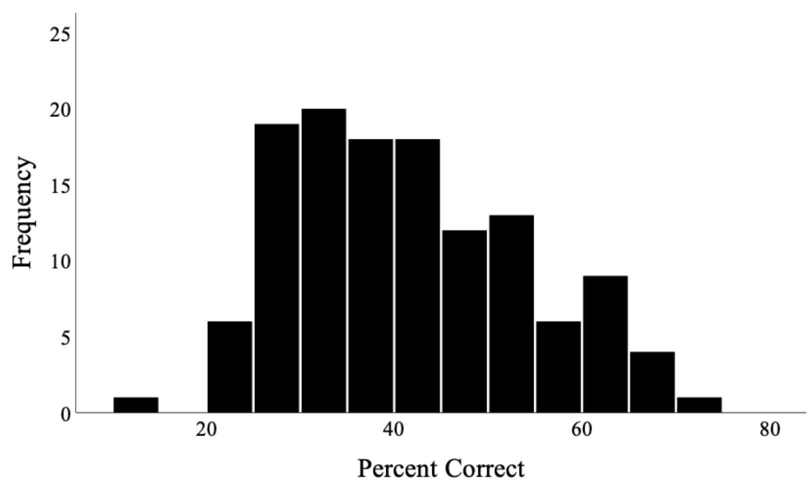
Figure 2: Histograms of *N*-back Performance Across Trials



between successive categories) for the first three trials was 2.36 (*SD* = 9.36, *n* = 91). Mean failure to maintain set (responding correctly for two or three items in a row but then answering the fourth item incorrectly) score was 5.10 (*SD* = 3.94).

Ultimately, percent trials correct was used as the indicator of overall performance on the WCST to be consistent with the literature using number of correct trials as an outcome measure (Kopp et al., 2021) while accounting for the variability in total trials completed. Visual inspection of WCST histogram (Figure 3) indicated mostly normal distribution with sufficient variability. Variables other than percent trials correct were not included in the present analyses due to lack of conceptual relevance (e.g., total number of trials, number of trials to complete first category), lack of variability within the sample (e.g., number of categories), skew within the sample (e.g., perseverative errors), and/or lack of precedence in EF literature as relevant to set-shifting abilities (e.g., learning to learn, failure to maintain set).

Figure 3: WCST Percent Trials Correct



EF Composite

Bivariate correlations indicated a moderate significant correlation between percentage of trials correct for the *n*-back and WCST, $r = .29$, $p < .01$. This correlation is consistent with Miyake's theory of executive functioning unity and diversity (2012) whereby EF components of updating, shifting, and inhibition share a common EF factor with additional updating-specific and shifting-specific variance for the respective components. Considering the *n*-back as a task measuring working memory and the WCST as a task measuring shifting abilities, we were interested in the overlap between working memory and shifting reflecting domain general executive functioning ability. Miyake and Friedman (2012) found a correlation of $r = .38$ for working memory and shifting abilities. Updating and shifting abilities have a relatively weak correlation as compared to the correlation between other EF abilities. Indeed, correlations between inhibition and shifting ($r = .79$) and inhibition and updating ($r = .77$) in the same study were strong (Miyake & Friedman, 2012).

Overall, weaker correlations between *n*-back and WCST performance in the current study did not support creating a composite variable of EF tasks. Additionally, analyzing the effects of working memory and shifting separately from one another allowed for clearer and more clinically relevant conclusions to be drawn from findings. Therefore, *n*-back and WCST performance were analyzed individually and tested as separate predictor variables of parenting.

Positive Parenting Composite

Coders completed 64 individual behavioral codes for the free play task and the frustration task: 22 codes for child reactions, 9 codes for child activity level/energy, 8 codes for parent-child interactions, and 25 codes for parent reactions. Individual codes of interest were pulled from the parent-child interaction and parent reaction codes based on theoretical alignment with the current aims and support from exploratory analyses. Codes were also selected to encompass potential cultural variation in expression of positive parenting by including several aspects of positive parenting such as positive affect, engagement, sensitivity, and structure. Additionally, broader codes such as the quality of the parent-child relationship and ability of parents to encourage or ease their child's participation further captured potential variability.

Descriptive statistics and bivariate correlations between individual items were examined. Ultimately, the following codes were supported by theoretical and statistical evidence (see Table 3) to be included in the positive parenting composite: "How often did the parent engage with the target child?", "Overall, how much of the time did the parent display positive affect?", "Rate the extent to which the parent was sensitive and responsive to the child's needs and cues", "Rate the parent's overall affect toward the child", "Rate the parent's ability to structure the environment or set limits and control the child", "Rate the extent to which the parent aided, encouraged, and/or eased child's participation in this session", and "Overall quality of this parent-child relationship".

Table 3: Correlations for LAB Tab Coder Ratings in Positive Parenting Composite

Variable	1	2	3	4	5	6
1. Skill responding to child's bids for reassurance						
2. Positive affect displayed by parent	.54**					
3. Sensitive and responsive to child's needs and cues	.45**	.56**				
4. Overall affect toward child	.46**	.67**	.65**			
5. Ability to structure environment or set limits	.28**	.36**	.50**	.44**		
6. Aided, encouraged, or eased child participation	.39**	.39**	.51**	.60**	.51**	
7. Overall quality of parent-child relationship	.36**	.43**	.62**	.64**	.49**	.75**

** $p < .01$ (two-tailed); * $p < .05$

Z-scores were calculated for each of the seven items due to differing scales (ratings from 1 to 5 versus 0 to 2). The standardized items were then averaged to create a positive parenting composite variable. When testing the internal reliability of items, Cronbach's alpha for the positive parenting composite variable was $\alpha = .88$. Exploratory analyses revealed no increase in Cronbach's alpha if any individual item were deleted from the scale. Therefore, these seven items were all retained in the positive parenting composite used in the analyses.

Negative Parenting Composite

Due to the coder ratings' focus on positive parenting strategies in general, few negative parenting coder ratings were available. The two negative parenting codes available were affect coding of parental anger during the task and intrusiveness with the child. These two codes were not significantly correlated with one another and demonstrated very poor Cronbach's alpha of $\alpha = .08$ when grouped into a composite variable, which is partially due to the low number of items included in the composite. Therefore, a negative parenting composite was not created and coder ratings were instead tested individually as intrusiveness and anger for both free play and frustration tasks.

Multi-Method Parenting Composite

One important objective of the current study was to examine whether EF predicts parenting across a variety of modalities. To test this aim, a parenting composite variable was created from the following modalities and respective variables: observed video coding, parent questionnaires, and observation of the home environment. Specific variables comprising the parenting composite were LAB Tab positive parenting for free play, Three-Bag positive parenting for free play, PSOC, PSI Parent-Child Dysfunctional Interaction scale, and HOME. Z-scores were calculated for each of these variables and the Z-score for PSI Parent-Child Dysfunctional interaction was multiplied by -1 in order to match the scale directionality of all other items. Finally, the five standardized items were averaged to create the overall parenting composite. Preliminary reliability of the overall, multi-method parenting composite demonstrated poor reliability, where Cronbach's alpha was $\alpha = .44$. Lower Cronbach's alpha was not unexpected given that the goal of the parenting composite variable was to capture combined variance of measures that assess parenting with differing methods. As such, the multi-method parenting composite was retained in analyses to test the Aim 1 hypothesis.

Aim 1

Aim 1 was addressed in SPSS using hierarchical linear regression to test whether caregiver executive functioning performance predicted parenting behaviors under ideal free play conditions without other demands. In each analysis, the exact *p*-value is provided for reference against conventional significance cutoffs (e.g., $p < .05$, $p < .01$) and to allow for calculation of corrections. Bivariate correlations examined initial relationships between EF task performance (*n*-back and WCST) and parenting as presented in Table 4. Results of bivariate correlations revealed a positive relationship between *n*-back performance and the multi-method parenting composite. Significant positive correlations were also found between the *n*-back and Three-Bag positive parenting, and between the *n*-back and HOME observation. *N*-back performance was negatively correlated with Three-Bag negative parenting and with caregiver ratings of parent-child dysfunctional interactions. WCST performance was related only to LAB Tab ratings of anger via a significant negative correlation.

Table 4: Correlations for EF and Free Play Parenting Variables

Variable	1	2	3	4	5	6	7	8	9	10
1. *n*-back										
2. WCST	.29**									
3. LAB Tab positive parenting	.09	.05								
4. LAB Tab intrusiveness	.04	-.14	-.25**							
5. LAB Tab anger	-.09	-.23**	-.23**	.04						
6. Three-Bag positive parenting	.29**	-.07	.44**	-.06	-.26**					
7. Three-Bag negative parenting	-.42**	-.12	-.38**	.22*	.38*	-.61**				
8. PSI dysfunctional parent-child	-.38**	-.06	.07	-.02	.05	-.20*	.23**			
9. PSOC	.18	.14	-.19*	.11	.03	-.18*	-.04	-.20*		
10. HOME	.40**	-.05	.20*	.03	-.16	.39**	-.37**	-.26*	.11	
11. Multi-method parenting composite	.48**	.05	.49**	-.05	-.24**	.66**	-.55**	-.57**	.34**	.70**

** $p < .01$ (two-tailed); * $p < .05$

Table 5: Correlations for Covariates, Multi-Method Parenting Composite, and Positive Parenting Variables

Variable	1	2	3	4	5	6	7	8	9	10	11
1. Child age											
2. Caregiver age	.12										
3. Language preference	-.16	-.21*									
4. CESD	.06	.14	.08								
5. Caregiver education	-.02	.06	.44**	-.01							
6. Poverty category	-.04	.13	.08	-.12	.30**						
7. Multi-method parenting composite	-.09	-.01	.07	-.35**	.32**	.28**					
8. LAB Tab positive parenting	.20*	-.00	.08	.00	.25**	.14	.49**				
9. Three-Bag positive parenting	.10	.10	.13	-.15	.33**	.22*	.66**	.44**			
10. PSI dysfunctional parent-child	.24**	.12	-.00	.32**	-.21*	-.09	-.57**	.07	-.20*		
11. PSOC	-.21*	-.10	-.02	-.22*	-.06	-.06	.34**	-.19*	-.18*	-.20*	
12. HOME	-.10	.11	-.01	-.29**	.16	.40**	.70**	.20*	.39**	-.26**	.11

** $p < .01$ (two-tailed); * $p < .05$

Covariates tested in all hierarchical regressions were child age, caregiver age, caregiver language preference, caregiver depressive symptoms (CESD), caregiver education, and poverty category. Bivariate correlations among covariates and parenting variables are displayed in Table 5. Correlations among covariates and predictor variables of working memory and set-shifting are presented in Table 6. Covariates were tested one at a time in the first block of each linear hierarchical regression. Covariates were retained if significant in the model and dropped from the regression model if not significant, with the exception of child age. Child age was retained in the first block of all regression models due to well-established differences in parenting throughout infancy, toddlerhood, and preschool (Bornstein et al., 2008), which were all stages represented by children's ages in the current study.

Table 6: Correlations for Covariates, Working Memory, and Set-Shifting

Variable	1	2	3	4	5	6	7
1. *n*-back							
2. WCST	.29**						
3. Child age	-.09	.09					
4. Caregiver age	-.04	-.22*	.12				
5. Language preference	.22*	.22*	-.16	-.21*			
6. CESD	-.23*	.04	.06	.14	.08		
7. Caregiver education	.42**	.30**	-.02	.06	.44**	-.01	
8. Poverty category	.28**	-.04	-.04	.13	.08	-.12	.30**

** $p < .01$ (two-tailed); * $p < .05$

To address Aim 1, two step hierarchical regression models were tested with multi-measure parenting as the dependent variable. Block one included covariates of child age, CESD, caregiver education, and poverty category. Block one was significant in the model predicting composite multi-method parenting, $R^2 = .24$, $F(4, 93) = 7.38$, $p < .001$. Results from block two revealed that caregiver performance on the *n*-back was a significant predictor of composite positive parenting, $R^2 = .34$, $F(5, 92) = 9.44$, $p < .001$, such that higher composite positive parenting was found among caregivers with fewer depressive symptoms, more education, and better working memory. In contrast, caregiver performance on the WCST was not a significant predictor of multi-method positive parenting, $R^2 = .26$, $F(5, 117) = 8.24$, $p = .969$, when controlling for child age, CESD, caregiver education, and poverty category in the first block, $R^2 = .26$, $F(4, 118) = 10.39$, $p < .001$. The first block was significant such that caregivers with higher composite positive parenting had fewer depressive symptoms and more education. These results from hierarchical linear regression with covariates entered into the model (Table 7) are consistent with bivariate correlation findings (see Table 4).

Table 7: Hierarchical Regression Analysis for EF as Predictor of Multi-Method Positive Parenting

Block and Variables	R^2	ΔR^2	ΔF	*B*	β	*t*
Block 1: Covariates	.24	.24	7.38**			
Child age				.00	-.06	-.63
CESD				-.02	-.34	-3.65**
Caregiver education				.10	.25	2.67**
Poverty category				.05	.11	1.11
Block 2: EF	.34	.10	13.64**			
n-back (*n* = 98)				.03	.36	3.69**
Block 1: Covariates	.26	.26	10.39**			
Child age				.00	-.05	-.64
CESD				-.02	-.35	-4.35**
Caregiver education				.11	.28	3.27**
Poverty category				.06	.14	1.68
Block 2: EF	.26	.00	.00			
WCST (*n* = 123)				.00	.00	-.04

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

In addition to positive parenting, negative parenting was also examined using hierarchical linear regression. EF skills (*n*-back, WCST) were tested as predictors of negative parenting behaviors, anger, and intrusiveness. See Table 8 for results. Overall, hierarchical regression revealed that *n*-back performance was a significant predictor of the Three-Bag coding negative parenting composite, $R^2 = .31$, $F(4, 92) = 10.43$, $p < .001$, after controlling for child age, caregiver education, and poverty category. Results demonstrated that more negative parenting was evident among caregivers with younger children, less education, and poorer working memory abilities. *N*-back performance was not a significant predictor of intrusive parenting during free play as observed with LAB TAB coding, $R^2 = .15$, $F(2, 98) = 8.88$, $p = .996$, when controlling for child age; nor a significant predictor of anger, $R^2 = .06$, $F(2, 98) = 3.13$, $p = .252$, when controlling for child age. Results from the first blocks of these two hierarchical regressions revealed that more anger and intrusiveness was observed among caregivers with younger children.

WCST performance significantly predicted LAB Tab caregiver anger during free play, $R^2 = .09$, $F(2, 124) = 5.85$, $p = .013$, when controlling for child age such that caregivers who exhibited more anger during free play had younger children and poorer set-shifting abilities. WCST performance was not predictive of LAB Tab intrusiveness during free play, $R^2 = .13$, $F(2, 124) = 9.29$, $p = .207$, though significant results for child age in block one demonstrated that caregivers who exhibited more intrusiveness were caregivers with younger children. Furthermore, when controlling for child age, caregiver education, and poverty category, WCST performance was not significant in predicting Three-Bag negative parenting, $R^2 = .19$, $F(4, 118) = 7.08$, $p = .523$.

Table 8: Hierarchical Regression Analysis of EF as Predictor of Negative Parenting Behaviors During Free Play

	Three-Bag Negative Parenting					LAB Tab Anger					LAB Tab Intrusiveness				
Block and Variables	R^2	ΔF	B	β	*t*	R^2	ΔF	B	β	*t*	R^2	ΔF	B	β	*t*
N	*100*					*101*					*101*				
Block 1: Covariates	.18	6.55**				.05	4.92*				.15	17.93**			
Child age			-.02	-.33	-3.48**			-.01	-.22	-2.22*			-.03	-.39	-4.24**
Caregiver education			-.09	-.19	-1.96*										
Poverty category			-.08	-.16	-1.60										
Block 2: EF	.31	10.43**				.06	3.13				.15	8.88			
n-back			-.04	-.42	-4.29**			-.01	-.11	-1.15			.00	.00	0.01
N	*123*					*127*					*127*				
Block 1: Covariates	.19	9.35**				.04	5.06*				.12	16.89**			
Child age			-.02	-.31	-3.72**			-.01	0.20	-2.25*			-.02	-.35	-4.11**
Caregiver education			-.10	-.20	-2.32*										
Poverty category			-.11	-.19	-2.23*										
Block 2: EF	.19	7.08				.09	5.85*				.13	9.29			
WCST			.00	-.06	-0.64			-.01	-.22	-2.53*			-.01	-.11	-1.27

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

Nevertheless, results from block one indicated that more negative parenting behaviors during free play were observed among caregivers with younger children, less education, and more socioeconomic risk. After controlling for covariates in the first block of each model, overall findings regarding EF and negative parenting behaviors are consistent with initial bivariate correlations (Table 4).

Aim 1 Post-Hoc Analyses

The five parenting variables making up the multi-method parenting composite demonstrated relatively low correlations with one another (see Table 5). Furthermore, bivariate correlations suggested unique relationships amongst the EF tasks and these five individual parenting components (Table 4). Therefore, post-hoc analyses were conducted to determine whether and how individual measures of positive parenting were related to caregiver EF. In order to correct for multiple comparisons due to running simultaneous hypothesis tests (see Lee & Lee, 2018), *p*-values were adjusted by controlling the false discovery rate using the Benjamini-Hochberg adjustment method (Benjamini & Hochberg, 1995).

Post-hoc exploratory analyses tested *n*-back and WCST performance as predictors of the five parenting variables making up the multi-method parenting composite: Three-Bag positive parenting, LAB Tab positive parenting, PSI dysfunctional parent-child interaction, PSOC, and HOME (see Tables 9 and 10 for results). Hierarchical regression tested *n*-back performance as a predictor of parent-reported stress on the PSI dysfunctional parent-child interaction scale. Block one controlled for child age, CESD, and caregiver education and was a significant predictor in the model, $R^2 = .18$, $F(3, 97) =$

6.86, $p < .001$, such that greater dysfunction in the parent-child relationship was found among caregivers with older children and more depressive symptoms. Block two results indicated that *n*-back performance significantly predicted additional variance in PSI over and above the covariates, $R^2 = .24$, $F(4, 96) = 7.74$, $p = .004$, adjusted $p = .040$, such that caregivers with poorer working memory reported greater dysfunction in parent-child interactions. When examining *n*-back performance as a predictor of total HOME observation scores, block one was significant for covariates of child age, CESD, and poverty category, $R^2 = .27$, $F(3, 89) = 10.80$, $p < .001$. In block two, *n*-back performance also significantly predicted HOME scores, $R^2 = .32$, $F(4, 88) = 10.51$, $p = .008$, adjusted $p = .040$. Results indicated that caregivers with a more nurturing HOME environment exhibited fewer depressive symptoms, less socioeconomic risk, and better working memory abilities. Hierarchical regression with PSOC as the dependent variable demonstrated that block one with covariates of child age and CESD was significant in the model, $R^2 = .07$, $F(2, 98) = 3.72$, $p = .028$, such that caregivers of younger children endorsed a higher sense of parenting competency. In contrast, *n*-back performance did not significantly predict PSOC scores when controlling for child age and CESD, $R^2 = .09$, $F(3, 97) = 3.12$, $p = .176$, adjusted $p = .293$.

In a hierarchical regression model with LAB Tab positive parenting as the dependent variable, block one consisting of covariates child age and caregiver education was significant in the model, $\mathrm{R}^2 = .12$, $F(2, 98) = 6.71$, $p = .002$, such that more positive parenting behaviors were observed during free play among caregivers with older children and more education. *N*-back performance, however, was not a significant predictor of positive parenting when entered in the second block of the model, $R^2 = .12$, $F(3, 97) = 4.43$, $p = .956$, adjusted $p = .956$. Similarly, block one with covariates child age, caregiver education, and poverty category was significant when testing Three-Bag positive parenting as the outcome variable, $R^2 = .14$, $F(3, 93) = 4.94$, $p = .003$, such that more positive parenting was observed among caregivers with more education. Performance on the *n*-back did not significantly predict positive parenting during free play as observed with the Three-Bag coding system in the second block of the model, $R^2 = .13$, $F(4, 92) = 4.43$, $p = .107$, adjusted $p = .214$.

Next, a series of hierarchical regression models tested set-shifting as a predictor of the five components comprising the multi-method parenting composite. When testing PSOC score as the outcome variable, covariates of child age and CESD constituted the first block which was a significant predictor in the model, $R^2 = .09$, $F(2, 124) = 5.92$, $p = .004$, where higher sense of competency in parenting was found among caregivers with younger children and fewer depressive symptoms. WCST predicted PSOC scores in the second block of the model while controlling for child age and CESD, $R^2 = .12$, $F(3, 123) = 5.38$, $p = .047$, but this finding was not significant after applying the Benjamini-Hochberg adjustment with adjusted $p = .157$. With Three-Bag positive parenting as the dependent variable, the first block controlling for child age, caregiver education, and poverty category was significant, $R^2 = .13$, $F(3, 119) = 6.13$, $p < .001$. WCST as a predictor of Three-Bag positive parenting during free play was trending toward significance, $R^2 = .16$, $F(4, 118) = 5.54$, $p = .068$, adjusted $p = .170$, such that more positive parenting during free play was found among caregivers with more education and a trending finding toward poorer set-shifting abilities.

Entering LAB Tab positive parenting as the dependent variable, block one with covariates child age and caregiver education was significant in the model, $R^2 = .12$, $F(2, 123) = 8.48$, $p < .001$, where caregivers exhibiting greater positive parenting behaviors were found to have older children and more education. The independent variable of interest, performance on the WCST, was not predictive of LAB Tab positive parenting during free play, $R^2 = .12$, $F(3, 122) = 5.76$, $p = .528$, adjusted $p = .754$. PSI score on the parent-child dysfunctional interaction scale was the next dependent variable tested in hierarchical regression. Block one controlling for child age, CESD, and caregiver education was significant, $R^2 = .19$, $F(3, 122) = 9.33$, $p < .001$, such that caregivers endorsing more dysfunctional parent-child interaction had older children, more depressive symptoms, and less education. In contrast, WCST performance did not significantly predict PSI parent-child dysfunctional interaction in block two, $R^2 = .19$, $F(4, 121) = 6.96$, $p = .799$, adjusted $p = .900$. In analyses evaluating HOME observation score as the outcome variable, block one with covariates child age, CESD, and poverty category was significant in the model, $R^2 = .25$, $F(3, 115) = 12.71$, $p < .001$. Higher ratings of the home environment were found among caregivers with fewer depressive symptoms and less socioeconomic risk. Performance on the WCST did not significantly predict HOME scores in block two after controlling for covariates, $R^2 = .25$, $F(4, 114) = 9.47$, $p = .810$, adjusted $p = .900$.

Table 9: Hierarchical Regression Analysis of EF as Predictor of Three-Bag and LAB Tab Positive Parenting Composites

	Three-Bag Positive Parenting					LAB Tab Positive Parenting				
Block and Variables	R^2	ΔF	B	β	*t*	R^2	ΔF	B	β	*t*
N	*97*					*101*				
Block 1: Covariates	.14	4.94**				.12	6.71**			
Child age			.01	.11	1.18			.02	.25	2.64*
Caregiver education			.18	.32	3.24**			.13	.25	2.67**
Poverty category			.06	.10	.95					
Block 2: EF	.16	2.65				.12	.00			
n-back			.02	.18	1.63			.00	.01	.06
N	*123*					*126*				
Block 1: Covariates	.13	6.13**				.12	8.48**			
Child age			.01	.11	1.31			.02	.22	2.59*
Caregiver education			.16	.29	3.22**			.15	.28	3.31**
Poverty category			.08	.13	1.40					
Block 2: EF	.16	3.40				.12	.40			
WCST			-.01	-.17	-1.84			.00	-.06	-.63

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

Note. Reported *p*-values in table are unadjusted.

Table 10: Hierarchical Regression Analysis of EF as Predictor of Parenting Questionnaires and Home Observation

	PSI					PSOC					HOME				
Block and Variables	R^2	ΔF	B	β	*t*	R^2	ΔF	B	β	*t*	R^2	ΔF	B	β	*t*
N	*101*					*101*					*93*				
Block 1: Covariates	.18	6.86**				.07	3.72*				.27	10.80**			
Child age			.12	.20	2.14*			-.12	-.21	-2.14*			-.12	-.13	-1.47
CESD			.19	.32	3.43**			-.09	-.16	-1.64			-.25	-.29	-3.08**
Caregiver education			-.58	-.15	-1.57										
Poverty category													2.32	.34	3.61**
Block 2: EF	.24	8.74**				.09	1.86				.32	7.33**			
n-back			-.27	-.30	-2.96**			.12	.14	1.36			.35	.25	2.71**
N	*126*					*127*					*119*				
Block 1: Covariates	.19	9.33**				.09	5.92**				.25	12.71**			
Child age			.12	.21	2.57*			-.12	-.21	-2.45*			-.08	-.08	-1.03
CESD			.18	.30	3.65**			-.11	-.19	-2.24*			-.26	-.27	-3.28**
Caregiver education			-.79	-.21	-2.52*										
Poverty category													2.59	.37	4.53**
Block 2: EF	.19	.07				.12	5.38*				.25	.06			
WCST			-.01	-.03	-.26			.07	.17	2.00*			-.01	-.02	-.24

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

Note. Reported *p*-values in table are unadjusted.

Aim 2

To address Aim 2, the same analyses performed for the LAB Tab parenting coder ratings in free play were replicated for the frustration task. That is, hierarchical regressions tested *n*-back and WCST performance as predictors of positive and negative parenting strategies during non-ideal conditions (i.e., involving a task designed to be frustrating for the child). Bivariate correlations were conducted among all EF and parenting variables for the frustration task (Table 11).

Table 11: Correlations for EF and LAB Tab Parenting Variables During Frustration Task

Variable	1	2	3	4
1. *n*-back				
2. WCST	.29**			
3. Positive parenting (frustration task)	.16	.21*		
4. Intrusiveness (frustration task)	-.04	-.14	-.25**	
5. Anger (frustration task)	-.04	.02	-.31**	.39**

** $p < .01$ (two-tailed); * $p < .05$

Hierarchical regressions evaluated positive parenting during the frustration task as the outcome variable (Table 12). When testing positive parenting during the frustration task, block one predictors of child age, caregiver education, and poverty category were significant in the model, $R^2 = .15$, $F(3, 87) = 4.96$, $p = .003$, such that more positive parenting behaviors during the frustration task were observed among caregivers with more education and less socioeconomic risk. *N*-back performance was not a significant predictor in block two, $R^2 = .15$, $F(4, 86) = 3.68$, $p = .871$. Next, intrusiveness during the frustration task was tested in the hierarchical regression model as the dependent variable. The covariate child age was a significant predictor of intrusiveness during the frustration task, $R^2 = .11$, $F(1, 92) = 11.77$, $p < .001$, where more caregiver intrusiveness was found among caregivers with younger children. *N*-back performance was not a significant predictor of intrusiveness in the frustration task, $R^2 = .12$, $F(2, 91) = 6.15$, $p = .447$. Anger during the frustration task was not significantly predicted by block one covariates of child age and poverty category, $R^2 = .03$, $F(2, 88) = 1.22$, $p = .300$, nor by block two *n*-back performance, $R^2 = .03$, $F(3, 87) = 0.81$, $p = .867$.

Next, a parallel set of regression analyses tested WCST as the independent variable (Table 12). With positive parenting during the frustration task as the outcome variable, block one with child age and poverty category as covariates was significant in the model, $R^2 = .07$, $F(2, 114) = 4.08$, $p = .019$. When controlling for child age and poverty, WCST significantly predicted positive parenting during the frustration task in block two of the model, $R^2 = .11$, $F(3, 113) = 4.54$, $p = .025$. Results from this set of analyses demonstrated greater positive parenting during the frustration task among caregivers with less socioeconomic risk and better set-shifting ability. However, this relation between WCST and positive parenting during the frustration task did not hold when adding caregiver education as a covariate. In the full model, child age, poverty category, and caregiver education were all added into the first block. This first block of covariates was significant in the model, $R^2 = .15$, $F(3, 112) = 6.49$, $p <.001$, such that greater positive parenting was observed among caregivers with older children and more education. Under these conditions, block two WCST was no longer predictive of positive parenting during the frustration task, $R^2 = .16$, $F(4, 111) = 5.24$, $p = .235$.

Negative parenting (i.e., intrusion, anger) during the frustration task was then explored as the outcome variable in a hierarchical regression. For intrusiveness during the frustration task, child age in block one was significant in the model, $R^2 = .10$, $F(1, 118) = 12.95$, $p < .001$, such that more intrusiveness was found for caregivers of younger children. WCST performance as included in block two was not a significant predictor of intrusiveness during the frustration task, $R^2 = .11$, $F(2, 117) = 7.46$, $p = .174$. Caregiver anger in the frustration task was included as the dependent variable in the following hierarchical regression analysis. There were no significant predictors in the model, with block one controlling for child age and poverty category, $R^2 = .02$, $F(2, 114) = 1.26$, $p = .289$, and block two examining WCST performance as a predictor, $R^2 = .02$, $F(3, 113) = 0.85$, $p = .823$.

Table 12: Hierarchical Regression Analysis of EF as Predictor of LAB Tab Parenting During Frustration Task

Block and Variables	LAB Tab Positive Parenting					LAB Tab Anger					LAB Tab Intrusiveness				
	R^2	***ΔF***	B	β	*t*	R^2	***ΔF***	B	β	*t*	R^2	***ΔF***	B	β	*t*
N	*91*					*91*					*94*				
Block 1: Covariates	.15	4.96**				.03	1.22				.11	11.77**			
Child age			.01	.20	1.99			.00	-.03	-.33			-.02	-.34	-3.43**
Caregiver education			.13	.32	3.01**										
Poverty category			.03	.07	.69			-.06	-.16	-1.52					
Block 2: EF	.15	.03				.03	.03				.12	.58			
n-back			.00	.02	.16			.00	.02	.17			-.01	-.08	-.76
N	*117*					*117*					*120*				
Block 1: Covariates	.07	4.08*				.02	1.26				.10	12.95**			
Child age			.01	.15	1.67			.00	-.05	-.55			-.02	-.31	-3.60**
Poverty category			.09	.21	2.30*			-.04	-.14	-1.48					
Block 2: EF	.11	5.16*				.02	.05				.11	1.87			
WCST			.01	.20	2.27*			.00	.02	.22			-.01	-.12	-1.37

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

Discussion

In a sample of primarily Latinx caregivers, we hypothesized that better caregiver EF (working memory and set-shifting) would predict increased positive parenting behaviors and decreased negative parenting behaviors during free play and frustration tasks, less parenting stress and more parenting self-efficacy as measured by self-report questionnaires, and a more enriching home environment as measured during the HOME observational rating. Findings partially supported this hypothesis, demonstrating that caregiver working memory, but not set-shifting abilities, predicted overall parenting under non-stress conditions.

These findings contribute to the growing body of work demonstrating that the individual EF components of working memory, shifting, and inhibition each provide unique impacts on parenting behaviors (Jones-Gordils et al., 2021). Working memory, for instance, may be more closely related to parenting behaviors because holding information in mind while manipulating new information is a valuable skill for parenting young children. Parenting is naturally a juggling act, so it would follow that caregivers' ability to manage multiple things simultaneously allows for greater engagement in supportive and nurturing parenting practices amidst the demands of raising a family.

Indeed, extant literature supports working memory as a distinct aspect of EF related to parenting behaviors. During interactions between mothers and their infants, greater observed maternal sensitivity was associated with better spatial working memory

(Gonzalez et al., 2012). Another study found that maternal working memory was positively associated with sensitivity during free play but not during a compliance task with 5-year-old children (Sturge-Apple et al., 2017). In the current study, greater caregiver working memory was associated with more positive parenting behaviors during free play, lower ratings of dysfunctional parent-child interaction, and a more enriching home environment. Working memory appears to influence aspects of parenting that range from more stable characteristics such as the everyday home environment to moment-by-moment interactions.

Less information, however, is available regarding the importance of set-shifting abilities in parenting. One of the only set-shifting studies known to the present author demonstrated an age-moderated relationship, whereby poorer set-shifting abilities were linked to less sensitivity and fewer vocalizations for teen mothers but not for adult mothers (Chico et al., 2014). Differing effects were also established for distinct EF subcomponents, whereby working memory mattered more for parenting behaviors in adult mothers and attentional set-shifting mattered more for teen mothers.

Given the lack of evidence for how set-shifting specifically impacts parenting, set-shifting results in the current study were of particular interest. Results did not reveal any significant relations between set-shifting and positive parenting during free play or on measures of everyday parenting. However, there is some evidence that set-shifting abilities in the current sample were related to positive parenting during the frustration task. One hypothesis is that set-shifting skills are activated only when a parent is shifting from one set of task parameters to another or when they must keep multiple competing goals in mind. During the frustration task, for instance, parents needed to switch between verbally encouraging their child to open the box, refraining from physically helping the child, and managing their own emotions or frustrations. In the frustration task, it is possible that parents with greater set-shifting abilities were able to more easily access positive parenting skills, applying them to a situation with very different instructions from the previous tasks and with multiple goals requiring greater cognitive flexibility. Indeed, a primary aim of the proposed work was to examine whether EF was especially important during tasks with increased demands.

In light of these findings about working memory and set-shifting abilities, one limitation of the current study is the absence of a measure of the executive function inhibition to create a more comprehensive model of EF and parenting. Inhibition includes the ability to override an automatic behavior or response and, along with other EF skills, engage in a more desired or appropriate behavior instead (Diamond, 2013). As such, inhibition is closely related to aspects of self-regulation such as effortful control, emotional control, and self-control (Crandall et al., 2015). Inhibition abilities allow parents to refrain from more reactive parenting and provides support for more intentional and sensitive parenting, especially during times or situations of higher cognitive conflict. For example, better inhibitory control was associated with greater caregiver sensitivity during a compliance-based clean-up task (Sturge-Apple et al., 2017). Adding a measure of inhibition in studies examining parenting in both ideal and stressed conditions would provide a more comprehensive and cohesive understanding of the impact of EF on parenting.

Accounting for all three subcomponents of EF (Miyake & Friedman, 2012) would also extend our understanding by allowing for exploration of parenting as it relates to the unity and diversity of EF; that is, are effects of EF on parenting driven by the underlying common EF factor, or are they specific to distinct attributes represented by inhibition, working memory, and shifting abilities? The current results would more closely support the latter hypothesis given that effects of working memory versus set-shifting differed based on task demands as well as the type of parenting measured. Because the correlation between shifting and working memory is much weaker than those between inhibitory control and the other two factors, we were unable to shed light on the role of a common EF factor influencing parenting abilities. Future research that includes all three components of EF should investigate both individual and group effects of EF on parenting.

Much of the research examining caregiver EF and parenting focuses on harsh or reactive parenting. The emphasis on positive parenting behaviors in the current study is intended to provide insight into whether EF supported caregivers' ability to increase sensitivity, warmth, and healthy boundaries. Nevertheless, there is also substantial evidence that harsh or reactive parenting is distinctly harmful for child development and more frequent among caregivers with poorer EF (Deater-Deckard et al., 2012). As such, we investigated this critical link between EF and negative parenting. In our sample of Latinx caregivers, better caregiver EF was linked to fewer negative parenting behaviors during parent-child interactions. More specifically, caregivers with better working memory abilities engaged in fewer Three-Bag coded negative parenting behaviors which included detachment, intrusion, and negative regard. Caregivers with greater set-shifting abilities exhibited less angry affect as observed with LAB Tab video coding of free play interactions.

These findings are in line with growing evidence that poorer caregiver EF is linked to negative parenting of young children (Bridgett et al., 2017). One existing theory for this pattern is that caregivers with poorer emotional regulation engage in more reactive parenting (Deater-Deckard et al., 2010); that is, caregivers who have a difficult time regulating their own emotions are less likely to engage in a calm, measured manner. Working memory deficits in particular are posited as a risk factor for harsh parenting (Sturge-Apple et al., 2014) and reactive negativity in parent-child interactions (Deater-Deckard et al., 2010). Combined with the finding that parents with poorer working memory engaged in more negative parenting behaviors during free play, working memory as an individual skill may play an important part in helping parents resist engaging in angry, intrusive, or reactive responses to child behavior (Rutherford et al., 2015). The link between set-shifting and caregiver anger in the current study is one of the first findings to establish a relation between set-shifting and parenting behavior. However, it is important to note that this pattern of angry affect did not extend to negative parenting behaviors toward the child. While set-shifting abilities may be related to emotional reactivity, it appears that other EF skills such as working memory are more vital to preventing engagement in negative parenting behaviors.

When interpreting results related to EF, the measurement of executive functions is an important factor in estimating the generalizability of findings to real-life impacts of EF on parenting. The naturalistic conditions under which EF tasks were completed in the current study lend increased confidence toward the findings' generalizability to caregiver utilization of EF skills in everyday parenting. The *n*-back and WCST were completed in the home setting. Even though all efforts were made to minimize distractions while caregivers were completing study activities, many characteristics of the typical home environment remained including inquisitive toddlers, pets, other siblings or children, other adults and occasional brief interruptions. Home settings varied widely and included temporary and crowded housing situations. Furthermore, caregivers had to manage any additional stress caused by the presence of researchers in their home. Taken together, the naturalistic every day setting may more accurately capture functional working memory and shifting abilities than measures completed in a lab environment. Additionally, similar correlations between working memory and shifting abilities in the current sample and in previous laboratory-based EF research (Friedman et al., 2008) support the conclusion that EF tasks in the home environment capture meaningful EF skills even amidst some chaos.

When contextualizing EF skills, it is important to keep in mind that one's ability to utilize EF in daily life and demonstrate EF ability are subject to the influence of other factors such as sleep and stress. It is well established that EF abilities such as working memory are significantly impeded by as little as one night of sleep deprivation (Lim & Dinges, 2010). Frequent, prolonged sleep loss can result in more longstanding exhaustion or fatigue that has similarly detrimental effects for EF (Kienhuis et al., 2010). Given that caregivers of infants and toddlers are often plagued by insufficient sleep, it is vital to consider caregiver sleep when studying EF in caregivers. Future directions for research might include a brief questionnaire for caregivers about their sleep the previous night and for the past week to explore how caregiver sleep impacts daily EF and parenting. Studies already utilizing sleep actigraphy for families could also utilize this strategy.

Higher order cognitive skills such as EF are also often the first to take a hit when experiencing stress or intense emotions. A systematic meta-analysis of stress and EF determined that acute stress negatively impacted working memory, cognitive flexibility, and cognitive inhibition (Shields et al., 2016). Other daily fluctuations that impact EF performance are negative affective mood states (Gabel & McAuley, 2018) and even experiencing physical pain (Bunk et al., 2019). Considering the many ways in which baseline EF abilities may be affected by daily states, testing EF at multiple timepoints along with measurement of daily functioning would provide a more robust understanding of individual EF and typical fluctuations. In the current study, caregiver depressive symptoms were indeed negatively associated with working memory performance ($r = -.23$, $p = .023$; see Table 6) but not with set-shifting. These results are supported by extant literature in which it is well-established that EF is impaired in depression (Austin et al., 2001). Caregiver CESD was also a significant covariate in several of the relations between EF and parenting, indicating that caregiver depression plays an important role in parenting behaviors.

Evidence that caregiver working memory impacts one's ability to engage in positive parenting strategies has important clinical implications. One of the most direct clinical applications is for parenting interventions. When engaging in positive parenting interventions or parent coaching, coaches should carefully consider caregivers' EF capacity. First of all, EF abilities impact the cognitive load each person is able to handle (Kolijn et al., 2021). Thus, it is important to consider how much new content a caregiver is able to take in during coaching sessions and under what conditions. For example, it may be that caregivers in general, particularly those experiencing low income and its associated demands, experience a heavy cognitive load that makes it more difficult to engage with new information. Therefore, it would be beneficial for clinicians delivering parenting interventions to consider how much content is delivered in each session. Some adaptations to consider are limiting the amount of content delivered per session or increasing the amount of repetition in consecutive sessions since repetition is helpful for those with limited EF (Kesler et al., 2013).

Another possible explanation is that EF limits a caregiver's ability to actively implement positive parenting strategies during interactions with their child despite having the appropriate knowledge. To explore these future directions, caregiver EF could be tested as a moderator of pre- to post-treatment growth following a parenting intervention. The knowledge versus implementation mechanisms of EF to positive parenting could be examined even more precisely by testing learned knowledge and utilizing observation of positive parenting skills during a parent-child interaction. The main question of interest would be whether caregiver EF moderates caregiver growth throughout the course of the parenting intervention. If so, we would test whether caregiver EF moderates growth in both knowledge learned and observed behaviors, or if that moderation were mechanism-specific. Although these questions are outside of the scope of the current study, future research can more clearly elucidate the role of caregiver EF in contributing to changes in parenting as instigated through interventions.

Other outcomes of the current study include findings illuminating the relation between EF and parenting for Latinx caregivers experiencing stress. Because stress can influence both EF and parenting abilities, insight into how they function together in this specific sample is particularly valuable. Experimental studies have established that experiencing acute stress impairs working memory and cognitive flexibility (Shields et al., 2016). Similarly, among Latinx and Black participants, experiencing both subtle and overt discrimination was linked to lower working memory (Ozier et al., 2019). Additional forms of stress such as acculturative stress can limit both EF and parenting abilities (Miller & Csizmadia, 2022). Therefore, positive parenting behaviors are crucial for children experiencing poverty, acculturative stress, and/or discrimination stress in order to buffer effects of this early life stress. In turn, results from this study suggest that supporting Latinx caregivers' EF skills when providing parenting coaching through early education, intervention, or therapy, can potentially bolster these caregivers in their positive parenting and further support their children's development.

The current study offers several strengths that contribute to a comprehensive investigation of EF and parenting. One strength is multi-method measurement of parenting by direct observation of parent-child interactions, parent report, and observation of the home environment. Given the multifaceted nature of parenting, the multidimensionality of the parenting data is an important attribute when trying to capture everyday parenting behaviors. Inclusion of multiple methods to measure parenting also allows for more in depth interpretation of results.

Another strength is utilizing both free play interaction and a frustration task that place increasing demands on the parent-child dyads and allow for observation of parenting under different conditions. Some studies have employed similar methodologies and achieved varying results. Sturge-Apple et al. (2017) found that working memory was associated with maternal sensitivity during free play, but not during a compliance-oriented task. Inhibitory control, on the other hand, was associated specifically with change in parenting sensitivity from free play to compliance. A study examining maternal sensitivity and discipline using only a compliance task, however, did not find any association between caregiver inhibitory control and sensitive discipline (Kolijn et al., 2021). Our findings show similar sensitivity to context and to individual EF skills with most of the EF and parenting connections observed during the free play task.

Taken together, it appears that free play tasks provide a valuable opportunity to observe naturalistic parenting while research exploring the role of EF in caregiving under stressful conditions is more nascent. As posited in Aim 2 of the current study, the hypothesis that caregiver EF would also be associated with parenting behaviors during the frustration task, in addition to during free play, was somewhat supported. While working memory did not predict positive or negative parenting during the frustration task, set-shifting was significantly related to positive parenting during the frustration task as demonstrated via bivariate correlations and in hierarchical regression, $p = .025$, when controlling for child age and poverty. However, regression results were non-significant when controlling for maternal education. Even so, results provide initial evidence that set-shifting may also play a role in positive parenting during a frustration task, though these results are likely underpowered and do not extend over and above the effect of caregiver education. Mixed results from other studies employing compliance or frustration tasks (e.g., Sturge-Apple et al., 2017) suggest that the complexity of non-free play tasks necessitates further research to clarify these patterns.

Caregiver education was a significant predictive factor in many of the hierarchical regression models. Indeed, more caregiver education in the current study predicted higher composite multi-method parenting, more positive parenting behaviors during free play and the frustration task, and less caregiver-reported parent-child dysfunctional interaction. With a wide range of caregiver education in the present sample, the relation between education and parenting behaviors is especially important to examine. Previous literature has established an association between maternal education and parenting such that parents with higher education engaged in more sensitive parenting (Tamis-LeMonda et al., 2009) and greater scaffolding of child behavior (Carr & Pike, 2012). In fact, the link between higher educational attainment and more nurturing parenting behaviors has been well-established for decades (e.g., Fox et al., 1995). The current findings provide further support for investigating caregiver education in parenting research by demonstrating that educational experience continues to be a key predictor of parenting behaviors. Additionally, the prevalent relation between education and parenting suggests that caregivers with less educational opportunity may be more likely to benefit from parenting education and coaching.

Limitations of this study include a smaller sample size which limits the strength of conclusions that can be drawn from the results. Additional power gained from more participants would allow for more complex conceptual models of the relations among working memory, set-shifting, and various aspects of parenting during free play and the frustration task. The present findings are also limited by the cross-sectional nature of the data which precludes drawing causal inferences or chronological directionality of effects. As previously mentioned, multiple timepoints of parenting observations within the context of a positive parenting intervention would be an excellent method by which to investigate changes in the impact of EF on parenting over time. Another avenue would be to address whether improving EF has downstream impacts on increased positive and decreased negative parenting; though direct EF training has mixed evidence for effectiveness, maintenance of skills, and generalizability beyond the specific task trained (e.g., Karbach & Kray, 2021; Melby-Lervåg & Hulme, 2013).

Despite these limitations, the current study provides valuable insight into the role of working memory and set-shifting for caregivers in parenting their children. Our findings specifically support working memory as an important factor influencing parenting behaviors, daily parenting, and the child’s home environment. Future directions include clarifying the role of general EF abilities versus working memory, inhibitory control, and set-shifting, as well as the conditions under which EF most strongly impacts parenting of young children.

Conclusion

Despite these limitations, the current study adds significant contribution by providing insight into the role of executive functions and parenting behaviors among primarily Latinx caregivers experiencing low income. Adding to a nascent literature examining EF and parenting, the current study demonstrated that better caregiver working memory, but not set-shifting abilities, predicted greater multi-method positive parenting behaviors. Regarding negative parenting behaviors, poorer working memory predicted more negative parenting behaviors during free play and poorer set-shifting predicted more caregiver anger during free play. During the frustration task, better set-shifting predicted more positive parenting behaviors though not over and above the impact of maternal education on parenting. Post-hoc analyses found that better caregiver working memory predicted less dysfunctional parent-child interaction and a more enriching home environment.

Limitations of this study include the smaller sample size and cross-sectional nature of the data which limit the strength of the conclusions. Larger sample size and longitudinal data would lend additional strength and further clarity to the present findings. Methodological strengths of the study include multi-method measurement of parenting, detailed behavioral coding of positive and negative parenting behaviors during free play and frustration tasks, and executive functioning tasks completed in the home setting. Clinical implications of this research propose that parenting interventions may improve efficacy by tailoring intervention material and coaching to account for EF diversity and deficits among parents of young children. Future directions include investigation of inhibitory control, in addition to working memory and set-shifting, to determine effects of a common EF factor versus individual executive functions on parenting. Longitudinal data examining changes in EF and/or parenting over time would also provide important insight into the role of EF in caregiver response to intervention.

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