EMOTION COREGULATION AND COERCIVE PROCESSES IN FAMILIES OF CHILDREN WITH BEHAVIOR DISORDERS: THE ROLE OF PARENTAL SELF - REGULATION

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A dissertation submitted to the faculty at the University of North Carolina at Chapel Hill in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Department of Psychology and Neuroscience (Clinical Psychology) in the Graduate School of Arts and Sciences.

Chapel Hill
2022

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ABSTRACT

Raelyn Loiselle: Emotion Coregulation and Coercive Processes in Families of Children with Behavior Disorders: The Role of Parental Self -Regulation
(Under the direction of Deborah J. Jones)

The parent-child relationship is implicated in the etiology and maintenance of early-onset behavior disorders (BDs); yet understanding and effectively targeting the underlying mechanism of treatment necessitates a better understanding of the role of parents' self-regulatory abilities including executive function (EF) and emotion regulation (ER), which may be especially important for parents of children with ADHD. To address this gap, this study examined the role of parental self-regulation (i.e., EF, ER) on (a) parent-reported negative parenting behaviors and reactivity to child negative emotions in a sample (N = 50) of families seeking services for clinically-significant problem behavior, (b) vocally encoded emotional arousal and coregulation in the context of parent-child interaction and (c) group differences in these relationships for parents of children with disruptive behavior disorder comorbid with ADHD. Findings revealed that emotion dysregulation was associated with negative disciplinary practices but not unsupportive reactions to child negative emotions. Parental EF was not associated with either construct of negative parenting practices. Analysis of interpersonal emotion dynamics indicated that parent EF was associated with greater aggregate child emotional arousal during a clean-up task but emotional coupling and coregulation were not associated with parent-reported ER or EF. Children with ADHD trended toward higher emotional arousal on a clean-up task and parents of children with ADHD coupled their emotional arousal with their child significantly more than parents of children without ADHD, suggesting a pattern of emotion co-dysregulation. Results should be interpreted with caution due to the small sample size and limited initial selection of analyses offered by these novel methods. Clinical implications and future directions are discussed.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ABBREVIATIONS

ADHD	Attention-Deficit/Hyperactivity Disorder
APIM	Actor-Partner Interdependence Model
BD	Behavioral Disorder
BPT	Behavioral Parent Training
BRIEF-A	Behavior Rating Inventory of Executive Function, Adult Version
CCNES	Coping with Child Negative Emotions Scale
CD	Conduct Disorder
CLO	Coupled linear oscillator
DERS	Difficulties with emotion regulation scale
ECBI	Eyberg Child Behavior Inventory
EF	Executive Function
ER	Emotion Regulation
ERSB	Emotion-Related Socialization Behaviors
F_0	Fundamental frequency
GEC	Global executive composite
MINI-KID	MINI International Neuropsychiatric Interview for Children and Adolescents
MLM	Multilevel model
ODD	Oppositional Defiant Disorder
OPS	O’Leary Parenting Scale

CHAPTER 1: INTRODUCTION

Behavior disorders (BDs), including oppositional defiant disorder (ODD) and conduct disorder (CD), which are highly comorbid with attention-deficit/hyperactivity disorder (ADHD; August et al., 1996; Bendiksen et al., 2017; Jensen et al., 2001), are among the most common disorders for which children and adolescents are referred for mental health services (e.g., Merikangas et al., 2009, 2010; Rushton et al., 2002; Steinberg & Drabick, 2015; Thapar et al., 2001; Zablotsky et al., 2018). The high rate of referrals may be an indicator of the strain that BDs have on families, schools, and communities. There is a significant societal burden associated with these disorders which is made even more substantial for children with early onset (i.e., ages 3-7 years) behavior problems. One study estimated that effective early intervention for just one high-risk child would save $3.2 to $5.5 million dollars (Cohen et al., 2010b, 2010a; Cohen & Piquero, 2009). Therefore, improving our understanding of the mechanisms that underlie the etiology and maintenance of these disorders is a public health imperative.

BDs fall into the category of externalizing disorders which are characterized by problems with self-regulation and disinhibition that lead to problems in their environment (American Psychiatric Association, 2013). In the DSM-5, ODD and CD are categorized as disruptive, impulse-control, and conduct disorders that involve problems with behavioral or emotional regulation. Though many psychological disorders are associated with behavioral and/or emotional regulation, the symptoms of ODD/CD are typified by aggression toward others or refusal to follow rules (Burke et al., 2014; Cohn & Adesman, 2015). In contrast, ADHD is a neurodevelopment disorder driven by delays in the development of executive functions (Barkley, 2001; Holmes et al., 2010) like inhibition (Berger et al., 2013; Gomez, 2003; Scheres et al., 2004; Snyder et al., 2015), working memory (Kofler et al., 2011; Kofler, Sarver, Austin, et al., 2018; Kofler, Sarver, Harmon, et al., 2018), internalized speech (Berk & Potts, 1991; Winsler, 1998), emotion and motivational arousal (Bunford et al., 2015; Lambek et al., 2018; Musser et al., 2013; Shaw et al., 2014), cognitive flexibility (Craig et al., 2016; Harris et al., 2014; Karalunas et al., 2018) that contribute to deficits in self-regulation and can result in disruptive behavior (Danforth et al., 2016; Factor et al., 2016; McQuade & Breaux, 2017). In a sense, the distress caused by a child's behavioral disorder at the time a family seeks services may not be felt by the child, but the child's behavior more acutely affects their social environment, most proximally their parents.

Elevated levels of parenting stress have been shown in families of children with BDs (Breen & Barkley, 1988; Johnson & Reader, 2002; Kadesjö et al., 2002). Parenting stress is specifically associated with a parent's perception that they are unable to meet the demands of parenting. This disconnect could be caused by limited resources due to parent characteristics, by excessive demands due to child characteristics, or both as both child and parent characteristics have been shown to contribute to parenting stress in this group (e.g., Abidin, 1997; DuPaul et al., 2001; Lin et al., 2017; Webster-Stratton, 1990;). In turn, parenting stress is linked to parenting practices (Deater-Deckard & Petrill, 2004; Theule et al., 2011) and problems in the parent-child relationship (Webster-Stratton, 1990; Belsky, 1984; Martorell & Bugental, 2006). These findings parallel etiological theories of childhood BDs which emphasize the reciprocal nature of parent and child psychosocial characteristics leading to a pattern of increasingly negative parenting behaviors and child problem behavior over time, known as the coercive cycle (Collins et al., 2000; Dishion, 2015; Granic & Patterson, 2006; Snyder 2016). Specifically, various parenting behaviors (e.g., inconsistent, lax, harsh) are linked to the exacerbation and maintenance of future child problem behavior (Bailey et al., 2009; Engfer & Schneewind, 1982; Hentges & Wang, 2018; Lansford et al., 2012; Wolford et al., 2019).

Though there is heterogeneity across families with regard to whether child characteristics (e.g. irritable temperament, developmental disabilities) or parent or family characteristics (e.g., psychopathology, chaotic home environment) contribute more significantly to risk in the parent-child system (e.g., Lunkenheimer et al., 2016; Pasalich et al., 2011; Scaramella & Leve, 2004), it is generally agreed upon that early intervention approaches should target these maladaptive parent-child dynamics (Gardner et al., 2007; Rooks-Ellis et al., 2020; Shaw et al., 2006; Webster-Stratton et al., 2004). Specifically, family-based behavioral interventions, such as Behavioral Parent Training (BPT), directly target parents' response to child behavior rather than directly intervening with the child. These treatments are considered the gold standard for treating BDs but require substantial effort and consistency on the part of the parent (e.g., Chacko et al., 2012, 2016, 2017, 2018; Jones et al., 2014; Georgeson, Highlander, Loiselle, et al., 2020). Essentially, parents are asked to "do" various new skills such as attending to and providing positive reinforcement for their child's adaptive or prosocial behavior, as well as articulating and enforcing clear rules and boundaries. They are also required to abide by many "don't" skills, such as inhibiting their response to their child's maladaptive behavior or inappropriate bids for attention (see Kaehler et al., 2016, for review). Scaffolding these skills requires parents to think in real time to inhibit a previously learned response to an aversive situation, assess the relevant components of that situation, and apply a new network of skills. Collectively, this process leans heavily on parent's cognitive and emotional resources, which are limited and can become depleted through subsequent self-control efforts (Baumeister et al., 2007; Muraven et al., 1998).

Parents who already may have more limited emotional and cognitive resources for parenting a child with behavior problems may struggle to incorporate new skills and routines into their day-to-day lives (Crandall et al., 2015; Johnston et al., 2012; Johnston & Chronis-Tuscano, 2017). With few notable exceptions (Chronis-Tuscano et al., 2011, 2017), it is surprising then that few programs of research have studied transdiagnostic deficits in self-regulation among parents in treatment (Maliken & Katz, 2013).

Parenting styles have been conceptualized as reflections of parents' goals and values distilled into day-to-day plans and actions (see Dix 2000 and McKee et al., 2013). Doing so requires parents to construct and implement such plans consistently yet flexibly across shifting demands and distractions. Longstanding theoretical models have suggested that parental psychological resources are likely the most proximal and influential predictor in parenting behavior (Belsky, 1984) and emotion socialization behaviors (Eisenberg et al., 1991; Johnson et al., 2017). Recent empirical research has focused on parent's ability to regulate themselves emotionally and cognitively while interacting with their children (Hajal & Paley, 2020; Park, Hudec, & Johnston, 2017; Shaffer & Obradovic, 2017). Among families who have children with a BD, for example during a tantrum, parents need to regulate their own distress, assess the components of the situation, and enact a response that will deescalate the behavior (Lorber et al., 2003; Lorber & O'Leary, 2005). Therefore, limitations in parental executive function and emotion regulation might contribute to the development and maintenance of BDs and explain the variability in the effectiveness of BPT for some families (Ben-Porath, 2010; Maliken & Katz, 2013; Niehaus et al., 2019).

Parental Self-Regulation

Self-regulation refers to one's effective control over their cognitive and emotional functioning and goal-directed behavior toward long-term targets and/or values (Hofmann et al., 2012; Karoly, 1993; Langner, Leiberg, Hoffstaedter, & Eickhoff, 2018). These intrapersonal emotion and cognitive capacities are demonstrated by the ability to plan, make decisions, hold information in mind, direct attention, set priorities, control impulses, and solve problems (Diamond, 2013). Many parenting behaviors included in models used to conceptualize the development of behavior disorders such as intrusiveness, harsh or inconsistent discipline, and negative reactivity to child behavior have been suggested to be linked with parental self-regulation (Bridgett et al., 2015; Deater-Deckard et al., 2010; Skowron & Platt, 2005; Yan et al., 2019). In the parenting literature, self-regulation has been operationalized most frequently by two interrelated domains: executive function (EF) and emotion regulation (ER) (Bridgett et al., 2015; Crandall et al., 2015, 2016, 2018; Mazursky-Horowitz et al., 2018).

There is discussion in the broader psychological literature as to whether emotion regulation and executive functioning are distinct domains or, rather, if emotion regulation is a component of executive function (Ochsner, Silvers, & Buhle, 2012). Recent empirical work has indicated modest and non-statistically significant associations between the two constructs that support the notion that they are distinct albeit closely related (Bridgett et al., 2013; Gyurak et al., 2009, 2012). Although recent research has started to address if and how these capacities differentially relate to parenting strategies, our understanding remains limited.

Executive Function and Parenting

Executive functions (EF) are a set of higher-order cognitive processes that serve to evaluate, plan, and direct behavior (Baddeley, 2007; Hofmann et al., 2012; Miyake et al., 2000).

Most empirical work supports three, interrelated EF processes including working memory (i.e., retaining and manipulating information in short-term memory), inhibitory control (i.e., overriding urges of behavioral response and ignoring distractions), and set-shifting or cognitive flexibility (i.e., updating mental information to meet shifting task demands; Chan et al., 2008; Miyake et al., 2000; Miyake & Friedman, 2012). These primary EFs contribute to several secondary processes such as planning (Jaroslawska et al., 2016; Kofler, Sarver, Harmon, et al., 2018), delay tolerance (Patros et al., 2016), proactive and reactive interference control (Hammad & Awed, 2016; Shipstead et al., 2012; Sidlauskaite et al., 2020), and goal-maintenance (Engle & Kane, 2004).

Functional abilities associated with EFs include time management skills, organization, and motivation, all of which contribute to social, occupational, and domestic functioning (Barkley, 1997; Barkley & Fischer, 2019). EF deficits make it challenging for individuals to maintain control over their lives, increasing the likelihood of acute stressors (i.e., missing appointments and deadlines, losing important items, work inefficiency) and contributing to feeling overwhelmed (Combs et al., 2015; Gjervan et al., 2012). Unfortunately, adults with EF deficits are more likely to have psychopathology (Bloemen et al., 2018; Snyder et al., 2015), but are less likely to benefit from interventions (McGough, 2016) and thus may have difficulty in skill-based interventions like BPT as well.

Indeed, much of the literature examining the contribution of parental EF on parenting behavior has focused on harsh and reactive parenting (e.g., Deater-Deckard et al., 2012; Crandall et al., 2018; Obravic & Shaffer, 2017). This line of research emerged based on early theories of EF deficits stating that individuals with lower self-control would be more likely to respond reactively and negatively (i.e., harsh parenting behavior) to challenging or aversive environments (i.e., child problem behavior; Dumas et al., 2001). Relatedly, research has found associations with parental EF and child neglect and abuse (Crouch et al., 2019)

In addition to the association with parental EF and harsh parenting, there is also evidence that deficits in working memory and inhibitory control are uniquely associated with lower maternal sensitivity and warmth (Obradovic et al., 2017; Shaffer & Obradovic, 2017; Sturge-Apple et al., 2017) as well as parenting behaviors that assist children structuring tasks such as scaffolding (Mazursky-Horowitz et al., 2018; Woods et al., 2021) and teaching (Obradovic & Shaffer, 2017). Similar to findings related to harsh parenting (e.g., Deater-Deckard et al., 2012), the association with lower EF contributing to reduced parental sensitivity and warmth is strongly in the context of elevated stress (Obradovic et al., 2017; Sturge-Apple et al., 2014; Sturge-Apple et al., 2016).

Emotion Regulation and Parenting

The concept of emotion regulation refers to an individual's ability to adapt their emotions in order to enact goal-oriented behaviors (e.g., Thompson 1994). The processes involved in emotion regulation include identification of emotion experienced, selection of an emotion regulation strategy, and then implementation of that strategy (Braunstein, Gross, & Ochsner, 2017; Koole, Webb, & Sheeran, 2015). For parents, this may mean that they resist the urge to yell at their child, despite experiencing frustration in response to their child's behavior, and instead engage in calm ignoring of the behavior. In this example, the parent is suppressing an emotion-congruent impulse (i.e., yell) and pushing themselves to engage in effective behavior (i.e., effortful ignoring) which is incongruent with their emotional experience and urge. Stressful, aversive, situations set the stage for escape/avoidance behaviors to cope (Lorber et al., 2016; Mence et al., 2014). Both overreactive and harsh parenting behaviors are associated with coercive parent-child dynamics and parents tend to swing back and forth between these behaviors, rather than only exhibiting one type (Lorber & Slep, 2005; Parent et al., 2016).

Self-reports of poorer parental emotion regulation have been related to both lax and overreactive disciplinary behaviors (Lorber, 2012; Woods et al., 2021) as well as higher reports of maternal rejections and lower maternal warmth (Saritaş et al., 2013). Emotion regulation has also been negatively associated with unsupportive responses to children's displays of emotion (Jaffe et al., 2010; Morelen et al., 2016; Shaffer et al., 2016) although not consistently (Woods et al., 2021). Investigators posited the lack of association between maternal ER and harsh responses to child negative emotions might be due to (a) overly structured tasks that did not capture the multitasking load of demands typically placed on parents in the real world and (b) unusually low child noncompliance and problem behavior in parent-child observations (Woods et al., 2021). When observed while interacting with their children in a challenging task, one study found that parents who reported more difficulties with ER, specifically problems generating effective emotion regulation strategies, had lower levels of positive collaborative behaviors and more emotionally-laden interactions defined by both the parent and the child simultaneously expressing negative emotions (Obradovic & Shaffer, 2017).

In the context of interpersonal relationships, the ability to regulate the expression of one's emotion to manage what affective information is communicated to others in the service of long or short-term goals. These goals might include suppressing the expression of frustration toward a child by intentionally modulating facial expression, body posture, and vocal tone to avoid upsetting the child, distracting the child from a task, reinforcing misbehavior, or damaging the relationship, among many other objectives. Accordingly, the dynamic assessment of parent emotion in the context of child behavior is necessary to capture the natural process and parse associations with parent self-regulation and parent behavior (Dennis-Tiwary, 2019).

Emotion-Related Socialization Behaviors (ERSBs). Conceptual models of emotion-related processes in children highlight the family context (see Paley & Hajel, 2022 for a review), including the role of parenting (Morris et al., 2007, 2017). Specifically, parents' use of emotion-related socialization behaviors (ERSBs) has been identified as a key mechanism promoting children's development of social behavior and social competence within nonclinical populations (Eisenberg, Cumberland, & Spinrad, 1998; Eisenberg, Spinrad, & Cumberland, 1998; Morris et al., 2017). ERSBs include parent's expression of emotions and reactions to children's emotions, which were posited to directly impact children's emotional arousal as well as their understanding of emotions. These behaviors fall into two broad categories: supportive parenting, such as validating, coaching, and helping children increase emotional awareness, and unsupportive parenting, such as minimizing, punishing, or panicking in response to child emotion (e.g., Eisenberg, Cumberland, & Spinrad, 1998; Gottman et al., 1996; McDowell, Kim, O'Neil, & Parke, 2002). Parents with ER difficulties are prone to displaying more dysregulation in the presence of their children and are also more likely to react unsupportively to their child's negative emotions (Kiel et al, 2017; Kohlhoff et al., 2016; McCullough et al., 2017; Morelen et al., 2016; Parent et al., 2011). In an early childhood community sample, both observed and parent-reported ER difficulties were associated with parent-reported unsupportive ERSBs (Morelen et al., 2016). The results of two studies indicate parent ERSBs may be concurrently (Zachary et al., 2019) and longitudinally (Johnson et al., 2017) associated with child problem behavior severity in a sample of children with early onset BDs. In Eisenberg's original model, parenting style is included as both a predictor of parent's use of ESRBs, as well as a moderator of the relation between ESRBs and emotional socialization (Eisenberg, Cumberland, & Spinrad, 1998; Eisenburg et al., 1996; Hajal & Paley, 2020; Paley & Hajal, 2022). Later work further emphasized the bidirectional relationship of parent and child characteristics (e.g., Lunkenheimer & Dishion, 2009). Now, current conceptualizations of this process employ a dynamic systems perspective (Lougheed et al., 2015, 2020; Peris & Miklowitz, 2015).

Parent-Child Emotion Coregulation

Parent-child coregulation reflects the dynamic moment-to-moment coordination of goal-oriented behaviors and expressed affect between child and parent (Calkins, 2011; Lunkenheimer, Kemp, et al., 2017; Olson & Lunkenheimer, 2009). Beginning in infancy, this coordinated exchange allows for parents to help children externally regulate with their assistance and over time this contributes to children developing their own self-regulation capacities (Feldman & Klein, 2003) Adaptive coregulation processes led by parents' guide regulation for children in increasingly challenging and complex circumstances and offer opportunity to implement self-regulation skills and strategies (Olsen & Lunkenheimer, 2009; Lunkenheimer, Kemp, et al., 2017). Parent-child coregulation in early childhood plays an important role in psychosocial development, affecting child's internalization of rules, self-control, and development of conduct problems (Boldt et al., 2020; Cole et al., 2003; Denham et al., 2000).

There is a well-developed body of work examining associations between maternal parenting and her psychophysiological measures of reactivity and self-regulation (see Butler & Randall, 2013, for a review). A consistent pattern of observed harsh parenting has been found among mothers who showed greater increases in sympathetic nervous system activity and weaker parasympathetic nervous system activity in response to cries from their infant or toddler (Joosen, Mesman, Bakermans-Kranenburg, & van IJzendoorn, 2013; Joosen, Mesman, Bakermans-Kranenburg, Pieper, et al., 2013; Martorell & Bugental, 2006; Mills-Koonce et al., 2009).

The affective and behavioral coregulation patterns between parents and children with behavior problems have been characterized as dynamic and interdependent across many studies using various methods (Busuito & Moore, 2017; Dumas et al., 2001; Rhoades et al., 2017; Smith et al., 2013). Evidence suggests that the shared emotional context of interaction with parent and children moderates the association between parent behavior and child compliance. In one such study, aversive dyadic-level emotions co-occurred with maternal control led to child noncompliance while positive dyadic emotions co-occurred with maternal control led to child compliance (Dumas et al., 2001). These findings are in line with early work with parenting typologies which showed the best long-term child outcomes were associated with parents who were high on control and high on warmth while much poorer outcomes were associated with high control in the absence of warmth (e.g., Baumrind, 1966). This underlines the importance of parent's ability to modulate their expression of emotion to contribute to short- (i.e., child compliance) and long-term goals (i.e., development of child self-regulation).

Assessing Dyadic Emotional Arousal through Vocal Pitch

Using physiological methods traditionally used to measure emotional arousal (e.g., heart rate, blood pressure, etc.) within an interpersonal context has significant disadvantages with regard to feasibility and ecological validity due to cumbersome equipment (see Kleinbub, 2017; Palumbo et al., 2017 for reviews of these methods). These issues are exacerbated when used with young children, especially those with BDs. However, measuring emotional arousal based on fundamental frequency (f_0) of the voice presents a more economic, unobtrusive, and noninvasive method as it can be derived from video and audio recordings of interactions (Narayanan &

Georgiou, 2013; Weusthoff et al., 2013, 2018). Several studies have demonstrated the reliability of f_0 as an indicator for emotional arousal (e.g., Fischer et al., 2017; Weusthoff et al., 2018; Weber et al., 2019). Technically, f_0 is defined as the frequency with which the vocal cords in the larynx vibrate which presents as the lowest frequency harmonic of a waveform during speech, as measured by Hertz (Hz; Lieberman & Blumstein, 1988). Increased vocal cord vibration occurs when the sympathetic nervous system is activated during emotional arousal. This is perceived as an increase in vocal pitch and functions as a paraverbal feature of nonverbal communication (Weusthoff et al., 2013). This method lends itself well to a dynamic systems perspective of interpersonal communication, allowing for moment-to-moment depiction of emotional arousal across time showing patterns of coregulation (Juslin & Scherer, 2005). These methods have been used primary in studies working with couples (e.g., Fischer et al., 2017; Janosik, 2005; Weber et al., 2019) as well as mothers with infants (Out et al., 2010). Despite the potential use for identifying underlying patterns of coregulation in interactions between parents and their young children with behavior disorders, f_0 methods have not been used with parent-child dyads in early childhood.

The Current Study

Building off the literature reviewed above, the current study extends our understanding of parent-child coregulation and coercive processes among families with clinically significant behavior problems. Notably, an article published in *Developmental Psychology* challenged developmental scientists to “rethink how we measure and conceptualize the quality of parent-child interactions” (Dennis-Tiwary 2019, p. 2007) and to do so by having “the courage--and methods--to tackle complexity” inherent in transactive interpersonal process (p. 2008). As such, this study examined three interrelated aims and corresponding hypotheses:

Part One Hypotheses

First, this study examined the unique contributions of parental EF and ER to negative parent behaviors associated with early childhood behavior problems. Current developmental psychopathology research on DBDs has increasingly emphasized the inclusion of both emotion socialization and coercion processes (e.g., Johnson et al., 2017). As discussed, coercive process in families involves a pattern of lax, permissive, or inconsistent parenting behaviors and harsh or overreactive parenting behaviors in response to child misbehavior which transact and lead to increasingly severe child problem behavior over time (e.g., Patterson 1982). Parents' level of emotional arousal increases the use maladaptive parenting behaviors functions to escape an aversive emotional experience quickly, even when this is not in line with parent's stated values (Rhoades et al., 2017; Rhoades & O'Leary, 2007). If the encounter occurs suddenly or escalates quickly, parents may experience overwhelm or disorientation (Gottman, et al., 1996; Lorber, Mitnik, & Slep, 2015). High chronic stress as well as acute arousal tends to narrow our view of the world which increases our preference for short term reward or relief (Mani et al., 2013). This level of arousal is evoked more easily for individuals with deficits in both ER and EF and tends to take longer to return to baseline after arousal (Gross 2003). It stands to reason that ineffective parenting behaviors (i.e., unsupportive ESRBs; negative discipline) would be influenced by the interaction of this vulnerability (i.e., deficits in self-regulation) and stressor (i.e., child disruptive behavior).

Previous research that has assessed parental EF in relation to parenting behavior have used laboratory tasks to tap specific executive function constructs (e.g., inhibition, working memory, cognitive flexibility; Bridgett et al., 2013, 2017; Lobo & Lunkenheimer, 2020) which have yielded inconsistent results. Several authors have speculated that the structure and predictability of these tasks as well as the absence of distractions or competing demands limited their generalizability to the "real world" experience of parents (Crouch et al., 2019; Roth et al., 2005). Alternatively, global self-report assessments gauge perceived EF abilities and deficits in the context of regular family life.

Despite theoretical work suggesting the distinct roles of parental ER and EF on parenting, the unique role of these constructs remains unclear, even among parents with typically developing young children (Crandall et al., 2015; Rutherford et al., 2015). In response to this gap in the literature, ER and EF will be included in models separately to examine unique associations with negative disciplinary behaviors as well as unsupportive ESRBs. Therefore, it is hypothesized that parental global EF and its interaction with child behavior severity will concurrently predict unsupportive parenting behaviors. Similarly, it is hypothesized that parent difficulties with ER and its interaction with child behavior severity will predict negative disciplinary behaviors. In addition, negative parenting behaviors are hypothesized to be predicted by concurrent parent EF and ER and their respective interactions with child behavior severity.

Part Two Hypotheses

Next, this study explored associations with parental self-regulation and emotional coregulation in parent-child observations using fundamental frequency. This method uses a homeostatic conceptualization of ER or the notion that ER reflects the ability to return to a stable set-point after being perturbed from that set-point (intrapersonal regulation), with stronger regulation indicated by faster set-point return (e.g., Boker & Laurenceau, 2006; Fischer et al., 2017; Story & Butner, 2010). Results will indicate (a) how quickly an individual returns to a baseline after becoming aroused and (b) whether that return to baseline occurs independent of the other personal's behavior (intrapersonal regulation) or, rather, the other person helps or hinders the individual's rate of return to their arousal baseline (interpersonal regulation). In addition, other analyses allow for a clarification of the extent to which the parent's and child's arousal levels are interrelated over time, and whether parent or child unidirectionally or bidirectionally influence one another.

Parent-child dyads' arousal will be measured over the course of two tasks designed to potentially evoke child problem behavior. In the clean-up task, parents are asked to direct their child to clean up toys for five minutes without assisting in the task themselves. The delay gratification task introduces a cookie for the child to have in five minutes after their parents complete their paperwork. These tasks might elicit noncompliance or aggressive behavior from the child, which parents will need to navigate along with the potential stressors of being under time pressure and on camera in a clinic setting. Aggregating across both tasks, it was expected that lower parental ER and EF abilities would be associated with higher arousal and longer time to return to baseline (i.e., sensitivity and regulation) during both interactions.

Part Three Hypotheses

Finally, this study compared coregulation patterns between parent-child dyads with and without comorbid child ADHD psychopathology. As discussed, ADHD is not considered a disruptive behavior disorder (i.e., ODD and CD) but is characterized by behavioral dysregulation that increases the likelihood of these children developing comorbid DBD secondarily (e.g., Breaux et al., 2017; Bunford et al., 2015; McQuade & Breaux, 2017). ADHD comorbidity represents a meaningful dimension of heterogeneity within the population of children with DBDs due to its relevance to etiology and intervention (Karalunas & Nigg, 2020; Nigg et al., 2020; Viding & McCrory, 2020). Prior research has consistently shown that BPT is an important component of treatment for children with ADHD to establish clarity, structure, and warmth for families at risk for coercion. Though, it has also become clear that ADHD moderates the effectiveness of BPT and many children with ADHD go on to require psychopharmacological interventions in the future, suggesting that parent-child process behavioral process may differ in this group (Chacko et al., 2017; Fabiano et al., 2015; Wymbs et al., 2015)

The role of self-regulatory constructs, such as ER and especially EF, for ADHD psychopathology have become increasingly studied in the past few years (Lambek et al., 2018; Nigg et al., 2020; Sonuga-Barke, 2014), which has been linked to various psychosocial and functional outcomes. Consistent with the designation of ADHD as a developmental disability (APA, 2013), children with ADHD develop social, educational, and functional skills more slowly and with greater difficulty than their typically developing peers, and they are more likely to exhibit subclinical symptoms associated with autism spectrum disorders and learning disabilities (Pauli-Pott et al., 2014; Steinberg & Drabick, 2015; Zablotsky et al., 2018). Furthermore, in early childhood, the prognosis of ADHD is chronic and lifelong (Thomas et al., 2015), unlike ODD which is more likely to remit with proper intervention (Kessler et al., 2012; Merikangas et al., 2009; Nock et al., 2007). Taken together, it is not surprising that parents of children with ADHD tend to report elevated stress, especially when exacerbated by comorbid disruptive behavior (Gadow & Nolan, 2002; Rockhill et al., 2013; van der Stoep et al., 2017). Thus, parents' self-regulatory resources may be more depleted due in part to increased caregiving demands. This likelihood is exacerbated by the high heritability of ADHD (i.e., 80% estimated) which increases the likelihood that a parent of a child with ADHD will have more symptoms associated with ADHD (including ER and EF deficits) themselves (Forehand et al., 2017; Shenaar-Golan et al., 2017a, 2017b).

Due to the indication of deficits in self-regulation among both individuals in a parent-child dyad, emotional coregulation may be negative impacted. To address this research question, we will examine group differences in emotional arousal and parent-child coregulation based on child ADHD comorbidity. It is hypothesized that these dyads would show higher arousal during the interaction tasks *and* take more time to return to baseline. Furthermore, it is expected that parents will have more difficulty influencing their child's regulation.

CHAPTER 2: METHODS

Participants

This study represents secondary analysis of baseline data of 50 families who sought enrollment in one evidence-based BPT program which was approved and monitored by the University of North Carolina Non-Biomedical Institutional Review Board. Families were recruited through online advertisements (e.g., Craigs List, University list-serves), schools and agencies, and word-of-mouth. Families who were eligible to participate had a child between the ages of 3 and 8 years old with clinically significant problem behavior based on Problem and Intensity subscales derived from the Eyberg Child Behavior Inventory (ECBI; Eyberg & Pincus, 1999). Families were excluded if the participating parent met diagnostic criteria for current substance abuse or dependence, psychotic disorder, or severe depression or manic episode, or if there was an active child protective services case. Children with established physical or developmental disabilities associated with social communication who would not be appropriately served with BPT were excluded. Of these 50 families who completed the baseline assessment battery and were eligible to participate, 45 attended their first BPT therapy session and officially enrolled in the treatment study. All families who completed the baseline assessment and were eligible for participation were included in this analysis regardless of whether they enrolled in the treatment portion of the study.

Participating children were a mean age of 4.81 years, approximately half girls (54%), and one-third (30%) identified as racial or ethnic minority. On average, parents were 38.58 years old, the majority were female (90%), and were employed at least part-time (76%). Regarding racial/ethnic diversity, 16% of parents self-identified as a member of a racial or ethnic minority group. See Table 1 in Appendix F for specific sample characteristics.

Procedure

Interested families contacted the project coordinator to complete a brief phone screen and online assessment to determine key eligibility criteria before proceeding to in-person assessment. Eligible families completed the baseline assessment in a community clinic where they provided parent consent for both parent and child participation, child assent, and confirmation of eligibility criteria. Finally, families engaged in interactions that were videorecorded and audio recorded. Once families completed all assessment requirements, they were paid for their participation in the assessment and scheduled for their first session of BPT.

Measures

Parent Emotion Regulation Difficulties

The Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004) was used to measure parent's emotion regulation. This 36-item measure yields a composite total score as well as scores for the following subscales: (a) Nonacceptance subscale, nonacceptance of negative emotions (6 items; $\alpha = .88$), (b) Goal subscale, difficulties in engaging in goal-directed behaviors when experiencing negative emotions (5 items; $\alpha = .90$), (c) Impulse subscale, impulse control difficulties (6 items; $\alpha = .0.81$), (d) Strategies subscale, limited access to emotion regulation strategies (8 items; $\alpha = .0.82$); (e) Awareness subscale, lack of emotional awareness (6 items; $\alpha = .0.88$) (f) Clarity subscale, lack of emotional clarity (5 items, $\alpha = .0.80$). The DERS has high internal consistency ($\alpha = .93$), good test–retest reliability, adequate construct and predictive validity (Gratz & Roemer, 2004), and is sensitive to change over time (Fox et al., 2008). See Appendix A for items and instructions.

Parent Executive Function

The Behavior Rating Inventory of Executive Function, Adult Version (BRIEF-A; Roth, Isquith, & Giola, 2005) was used to measure facets of parent's executive function. This 75-item measure yields three composites scores comprised of nine subscales including 1) *Inhibit*: assesses inhibitory control and impulsivity, ability to resist impulses and ability to stop one's own behavior at the appropriate time, (8 items; α = .0.76) (2) *Shift*: ability to move with ease from one situation, activity, or aspect of a problem to another as the circumstances demand, ability to make transitions, tolerate change, problem-solve flexibly, switch or alternate attention, change focus from one mindset or topic to another, (8 items; α = .74). 3) *Emotional Control*: measures impact of executive function problems on emotional expression, ability to modulate or control emotional responses, (10 items; α = .0.86). 4) *Self-Monitor*: assesses aspects of social or interpersonal awareness, captures degree to which individual perceives himself as aware of the effect his behavior has on others, (6 items; α = .70). 5) *Initiate*: ability to begin a task or activity and independently generate ideas, responses, or problem-solving strategies (8 items; α = .85). 6) *Working Memory*: capacity to hold information in mind for the purpose of completing a task, essential to carrying out multistep activities, completing mental manipulations, and following complex instructions, (8 items; α = .88). 7) *Plan/Organize*: ability to manage current and future-oriented task demands, planning captures ability to develop appropriate sequential steps ahead of time to carry out a task; organizing captures ability to bring order to information and appreciate main ideas or key concepts when learning or communicating information, (10 items; α = .90). 8) *Task Monitor*: ability to keep track of one's problem-solving success or failure to identify and correct mistakes during behaviors, (6 items; α = .76). 9) *Organization of Materials*: measures orderliness of work, living, and storage spaces (8 items; α = .85). Behavioral Regulation Index is comprised of Inhibition, Shift, Emotional Control, Self Monitor, and Initiate scales (30 items; α = .90). Metacognitive Index is comprised of Working Memory, Plan/Organization, Task Monitor, and Organization of Materials (40 items; α = .96). General Executive Composite (GEC) is comprised of all subscales (70 items; α = .97). See Appendix B for items and instructions.

Caregiver Response to Child Emotions

The Coping with Children's Negative Emotions Scale (CCNES; Fabes, Eisenberg, & Bernzweig, 2002) served as the measure of caregiver emotion socialization practices. The CCNES consists of six 12-item subscales that assess separate parental coping responses in reaction to young children's negative emotions: 1) Problem-Focused Reactions (12 items; α = .85), 2) Emotion-Focused Reactions (12 items; α = .83), 3) Expressive Encouragement (12 items; α = .93), 4) Minimization Reactions (12 items; α = .78), 5) Punitive Reactions (12 items; α = .64), and 6) Distress Reactions (12 items; α = .62). Building upon prior theory regarding the role of emotion regulation and socialization in children with DBDs in particular and using an example from prior research (Denham & Kochanoff, 2002), these subscales were grouped into two broader domains of *Parental Reactions to Children's Emotions* (CCNES Reactions, including Distress, Minimization, and Punitive Reactions), with higher levels reflecting more maladaptive or unsupportive aspects of emotion socialization, and *Parental Coaching of Children's Emotions* (CCNES Coaching, including Expressive Encouragement, Emotion-focused and Problem-focused Responses), with higher scores reflecting more adaptive or supportive responses. Previous studies have demonstrated that the CCNES has good internal and test-retest reliability and is sensitive to change over time (e.g., Denham & Kochanoff, 2002; Eisenberg & Fabes, 1994; Herbert et al., 2013). The current study will be exclusively using the CCNES Reactions Scale. See Appendix C for items and instructions.

Negative Parenting

O'Leary Parenting Scale (PS; Arnold, O'Leary, Wolff, & Acker, 1993) is comprised of 30 items that ask caregivers the probability, on a scale from 1 to 7, with which the parent uses particular discipline strategies. The OPS yields one total score and two subscales: Laxness (permissive, inconsistent discipline); Over-reactivity (harsh, emotional, authoritarian discipline and irritability). The scale has adequate internal consistency; has previously been found to have good test-retest reliability, to discriminate between parents of clinic and non-clinic children, and to correlate with self-report measures of child behavior, marital discord and depressive symptoms, and also with observational measures of dysfunctional discipline and child behavior (Arnold et al., 1993). Total OPS (30 items; $\alpha = .76$), Over-reactivity scale (10 items; $\alpha = .72$), Laxness scale (11 items; $\alpha = .83$). See Appendix D for items and instructions.

Child ADHD Diagnosis

The MINI International Neuropsychiatric Interview for Children and Adolescents (MINI-KID; Sheehan et al., 1998) is a short, structured diagnostic interview used to assess the presence of 24 DSM-5 child and adolescent psychiatric disorders. The MINI-KID has been shown to have psychometrics comparable to the Schedule for Affective Disorders and Schizophrenia for School Aged Children-Present and Lifetime Version (K-SADS-PL; Kaufman et al., 1997), with only a fraction (1/3) of the interview time (Sheehan et al., 1998). This measure was used to identify child diagnosis of ADHD in accordance with DSM-5 (APA, 2013) criterion.

Child Problem Behavior

Intensity and Problem subscales on the 36-item ECBI (Eyberg & Pincus, 1999) served as the dependent measure given the availability of normative data (Burns et al., 1991) and established psychometrics (e.g., Fernandez et al., 2011). Each item prompts parents to rate the intensity of a specific behavior occurring (0 = *never* to 7 =*always*) and whether they consider each behavior to be a problem (0 = *no*; 1= *yes*). Scores that are two or more standard deviations above the normed mean of each subscale illustrates clinical significance (Intensity clinical cutoff =131; Problem clinical cutoff = 15). ECBI Intensity (α = .86) and ECBI Problem (α = .85). See Appendix E for items and instructions.

Vocal Pitch Frequency

Parent-child interactions were used to examine vocally encoded emotional arousal (i.e., fundamental frequency (f_0); Juslin & Scherer, 2005). Recordings were obtained using a boundary microphone to record both parent and child, as well as a directional Lavalier microphone carried by the parent. With this setup, child speech could be distinguished from parent speech efficiently. Estimates of f_0 were obtained every .25 second using Praat with a band pass filter to restrict extraction to the natural pitch of adults and children. This approach stems from a homeostatic conceptualization of ER or the notion that ER reflects the ability to return to a stable set-point after being perturbed from that set-point (intrapersonal regulation), with stronger regulation indicated by faster set-point return (e.g., Boker & Laurenceau, 2006; Fischer et al., 2017; Story & Butner, 2010).

Recordings were manually segmented into separate tracks for parent and child using Audacity 3.0.5 (http://www.audacityteam.org). In addition, background noises and non-verbal vocalizations (e.g., laughter, crying) were removed. Estimates of f_0 were identified every .25 second using robust pitch extraction algorithms in Praat (Boersma & Weenink, 2018) with a band pass filter of 75-300 Hz to restrict extraction exclusively to the range of natural speech for adults and extended the band pass filter to 500 Hz for children (Owren & Bachorowski, 2007). F0 at each talk turn were plotted for each dyad and observation, generated in Stata (StataCorp, 2019), and were visually inspected for instances of non-speech sounds in the data. In these cases, the talk turn was investigated using specific f_0 estimations for each 0.25 second interval and/or audio tracks were reviewed to ensure there was no interference.

CHAPTER 3: RESULTS

Mean scores for DERS total score were 69.98 (*SD* = 19.47) and mean scores for BRIEF GEC were 97.59 (*SD* = 21.90). The OPS total score mean was 98.25 (*SD* = 15.30) and the CCNES Reactivity scale mean was 84.27 (*SD* = 18.91). ECBI Problem scale mean was 22.45 (*SD* = 6.30). See Table 1 in Appendix F for sample characteristics. Note: ER represents results from the *difficulties* with emotion regulation based on scores on the DERS, where higher scores indicate greater dysregulation. Similarly, EF represents difficulties associated with poor executive function based on the BRIEF GEC, where higher scores indicate greater dysregulation.

Aim 1

Pearson Correlations

Analyses at the dyad level were conducted using SPSS 27 (IBM Corp, 2019). First, Pearson correlations between variables of interest and possible covariates were examined. Significant findings are reported here, please see Table 2 in Appendix F for all correlations.

Total negative parenting behaviors, measured by OPS, were significantly positively correlated with parent reported problems with emotion regulation (DERS; $r = 0.340$, $p < 0.05$) but not general executive function deficits (BRIEF GEC). Total negative parenting behaviors were positivity correlated with parent negative reactions to child negative emotions (CCNES Reactions; $r = 0.541$, $p < 0.01$). Negative parenting behaviors were not correlated significantly with child ADHD diagnosis or problem behavior severity. No significant correlations were observed across child and parent demographic characteristics.

Parent responses to child negative emotions. Parent reactivity to negative child emotions (CCNES Reactivity) was positively correlated with parent problems with emotion regulation (DERS; $r = 0.341$, $p < 0.05$) and negative parenting behaviors (OPS; $r = 0.541$, $p < 0.01$). No significant correlations found between CCNES Reactivity and demographic characteristics, child ADHD, or child behavioral severity.

Parent self-regulation variables. Parent difficulties with emotion regulation was positively associated with child gender, specifically that parents of girls reported greater problems with ER ($r = 0.290$; $p < 0.05$). Parent ER problems were also positively correlated with general executive function deficits (BRIEF GEC; $r = 0.496$; $p < 0.01$). Parent EF problems were significantly positively correlated with child ADHD diagnosis ($r = 0.337$, $p < 0.05$). Significant correlations with parent responses to child negative emotions (CCNES) and with negative parenting behaviors (OPS) are reported above.

Regression Analyses

Four separate main effect models were conducted for each independent variable for parental self-regulatory (i.e., ER and EF) on both dependent variables of parenting behavior, CCNES Reactions and OPS. Then, child problem behavior (ECBI intensity) was added to each model to examine the possible moderating role of child behavior, as hypothesized. Both parent ER and EF were added to the same linear regression model to examine the unique contribution of ER/EF to both emotion and disciplinary parenting behaviors, respectively. All predictor variables were centered to aid in interpretation and comparison across coefficients and add interactions between variables in the models. Linear model assumptions were checked for all models using standard diagnostics. Additionally, diagnostics were performed to identify outliers and extreme and/or influential values for predictors and outcomes. The Benjamini and Hochberg (1995) adjustment for multiple hypothesis testing was used adjust *p* values to prevent Type 1 error. See Table 3 in Appendix F for all results.

Multiple Regression Analyses: Negative Parenting Behaviors as Outcome Variable

Parent emotion regulation as independent variable. Simple linear regression was used to test if DERS was significantly associated with OPS. The fitted regression model was: OPS = 98.729 + 0.268**DERS* + ε. The main effect of parent problems with ER on negative parenting behaviors was statistically significant and explained 11.5% of the variance in problems with ER (R^2= 0.115, $F(1,48) = 6.266$, $p = 0.016$). It was found that DERS significantly predicted OPS (β=0.268, $p = 0.016$), such that one unit increase in reported problems with emotion regulation increased reported negative parenting behaviors scale by 0.268.

Child problem behaviors, measured by ECBI Problem Scale, were added to the model to assess the relationship between parent ER and negative parenting behaviors when holding child problem behavior constant. Multiple regression model was fit: OPS = $\beta_0+\beta_1 DERS+\beta_2 ECBIproblems+\varepsilon$. The model fit was not statistically significant with ECBI problems added, the amount of ER variance explained by predictors remained 11.5 % (R^2= 0.115; $F(2,47) = 3.069$, $p = 0.056$). Although DERS continued to significantly predict OPS (β=0.268, $p = 0.017$) while holding ECBI Problems constant. However, ECBI Problems did not significantly predict OPS ($\beta = -0.003$, $p = 0.992$).

To assess moderator effect of problem behavior and emotion regulation, an interaction term was added to the multiple regression model for DERS and ECBI Problems, representing the effect of emotion regulation given child problem behavior on negative parenting behaviors. Multiple regression model was fit: OPS = $\beta_0+\beta_1 DERS+\beta_2 ECBIProb*DERS+\varepsilon$. The main effect was statistically significant and the predictor variables explained 13% of the variance in parent negative behaviors (R^2 = 0.130; F(2,47) = 3.512, p = 0.038) however the difference in model fit from the restricted model, with only DERS as predictor, was not statistically significant (F_1-F_2= 0.786, p = 0.380). Parent emotion regulation significantly predicted OPS (β = 0.286, p = 0.112) while holding the interaction between parent emotion regulation given child behavior problems. The interaction between parent emotion regulation and child behavior problems did not significantly predict negative parenting behaviors (β = -0.017, p = 0.380).

Parent problems with executive function as independent variable. Simple linear regression was used to test if BRIEF GEC significantly predicted OPS. The fitted regression model was: OPS = 98.653 + 0.124*GEC + ε. The main effect of parent problems with EF on negative parenting behaviors was not statistically significant and only explained 3.1% of the of the variance in problems with EF (R^2= 0.031; F(1,48) = 1.531, p = 0.222). It was found that GEC did not significantly predict OPS (β = 0.124, p = 0.222), such that one unit increase in reported problems with executive function increased reported negative parenting behaviors scale by 0.124.

Child problem behaviors, measured by ECBI Problem Scale, were added to the model to assess the relationship between parent EF and negative parenting behaviors when holding child problem behavior constant. Multiple regression model was fit: OPS = β_0+β_1GEC+β_2ECBIprob+ε. The model fit was not statistically significant with ECBI problems added, the amount of EF variance explained by predictors remained 3.3 % (R^2 = 0.033; F(2,47) = 0.795, p = 0.458). Neither GEC (β = 0.130, p = 0.214) nor ECBI Problems Scale (β = -0.106, p = 0.768) significantly predicted OPS.

To assess moderator effect of problem behavior and executive function, an interaction term was added to the multiple regression model for EF and ECBI Problems, representing the effect of executive function given child problem behavior on negative parenting behaviors. Multiple regression model was fit: OPS = $\beta_0 + \beta_1$GEC + β_2ECBIProb*GEC+ε. The main effect was not statistically significant and the predictor variables explained 3.3% of the variance in parent negative behaviors ($R^2 = 0.033$; $F(2,47) = 0.531$, $p = 0.664$).

Parent ER, EF, and interaction of ER and EF as predictor variables. Parent problems with emotion regulation and executive function were added to a multiple regression model predicting negative parenting behaviors. Multiple regression model was fit: OPS = $\beta_0 + \beta_1$GEC + β_2DERS + ε. The main effect was not statistically significant and the predictor variables explained 11.6 % of the variance in parent negative behaviors ($R^2 = 0.116$; $F(2,47) = 0.3.070$, $p = 0.056$). Although the main effect only approached significance, parent problems with emotion regulation continued to predict OPS ($\beta = -0.265$, $p = 0.039$) while parent problem with executive function did not significantly predict OPS ($\beta = 0.007$, $p = 0.951$). An interaction term was added to this model for GEC and DERS scores. Multiple regression model: OPS = $\beta_0 + \beta_1$GEC + β_2DERS + β_3DERS*GEC + ε. The change in R-squared was minimal (0.002) with this interaction added and the main effect remained not statistically significant ($R^2 = 0.118$; $F(3,46) = 2.044$, $p = 0.121$).

Multiple Regression Analyses: Parent Unsupportive Responses to Child Negative Emotions as Outcome Variable

Parent emotion regulation as independent variable. Simple linear regression was used to test if DERS significantly predicted CCNES Reactions. Case-wise diagnostics identified one outlier case with residuals 3 SDs from the mean (FAMID = 17), with an extreme CCNES Reactions score = 163. This case was removed from regression models for DERS and CCNES Reactions. The fitted regression model was: CCNES Reactions = 83.060 + 0.176*DERS + e. The main effect of parent problems with ER on unsupportive parent reactions to child emotions was not statistically significant and explained 4.8% of the variance in unsupportive reactions to child negative emotions (R^2 = 0.048; F(1,48) = 2.373, p = 0.130).

Child problem behaviors, measured by ECBI Problem Scale, was added to the model to assess the relationship between parent ER and unsupportive parenting reactions to child negative emotions when holding child problem behavior constant. Multiple regression model was fit: CCNES Reactions= $\beta_0+\beta_1$DERS$+\beta_2$ECBIproblems+ε. The model fit was not statistically significant with ECBI problems added, the amount of ER variance explained by predictors was 5.5 % (R^2= 0.055; F(2,47) = 1.329, p = 0.275).

To assess moderator effect of problem behavior and emotion regulation, an interaction term was added to the multiple regression model for DERS and ECBI Problems, representing the effect of emotion regulation given child problem behavior on unsupportive parenting reactions to child negative emotions. Multiple regression model was fit: CCNES Reactions = β_0 + β_1DERS + β_2ECBIProb + β_3ECBIProb*DERS + ε. The main effect was not statistically significant and the predictor variables explained 7.7% of the variance in parent negative behaviors (R^2 = 0.077; F(3,46) = 1.244, p = 0.305).

Parent problems with executive function as independent variable. Simple linear regression was used to test if BRIEF GEC significantly predicted CCNES Reactions. The fitted regression model was: CCNES Reactions = 84.530 + 0.212*GEC + e. The main effect of parent problems with EF on unsupportive parenting responses was not statistically significant and only explained 6.1% of the of the variance in problems with EF (R^2 = 0.061; F(1,48) = 3.094, p = 0.085).

Child problem behaviors, measured by ECBI Problem Scale, were added to the model to assess the relationship between parent EF and negative parenting behaviors when holding child problem behavior constant. Multiple regression model was fit: CCNES Reactions = $\beta_0 + \beta_1$GEC + β_2ECBIproblems + ε. The model fit was not statistically significant with ECBI problems added, the amount of EF variance explained by predictors was 6.6 % ($R^2 = 0.066$; $F(2,47) = 1.665$, $p = 0.200$). GEC did not significantly predict CCNES Reactions holding child problem behaviors constant ($\beta = 0.200$, $p = 0.112$). Child problem behaviors did not significantly predict CCNES Reactions holding parent executive function constant ($\beta = 0.228$, $p = 0.598$).

To assess moderator effect of problem behavior and executive function, an interaction term was added to the multiple regression model for EF and ECBI Problems, representing the effect of executive function given child problem behavior on unsupportive parenting behaviors. Multiple regression model was fit: CCNES Reactions = $\beta_0 + \beta_1$GEC + β_2ECBIproblems + β_3ECBIProb*GEC + ε. The main effect was not statistically significant and the predictor variables explained 13.4% of the variance in parent negative behaviors ($R^2 = 0.134$; $F(3,46) = 2.373$, $p = 0.082$).

Parent problems with EF, ER, and the interaction of EF and ER as predictor variables. Parent problems with emotion regulation and executive function were added to a multiple regression model predicting unsupportive parenting behaviors. Multiple regression model was fit: CCNES Reactions = $\beta_0 + \beta_1$GEC + β_2DERS + ε. The main effect was not statistically significant and the predictor variables explained 7.7 % of the variance in parent negative behaviors ($R^2 = 0.077$; $F(2,47) = 1.912$, $p = 0.159$). An interaction term was added to this model for GEC and DERS scores. Multiple regression model: CCNES Reactions = β_0 + β_1GEC + β_2DERS + β_3DERS*GEC + ε. The change in R-squared was minimal (0.001) with this interaction added and the main effect remained not statistically significant ($R^2 = 0.078$; $F(3,46) = 1.260$, $p = 0.299$).

Aim 1 Results Summary

It was hypothesized that both parent-reported problems with emotion regulation as well as problems with executive function would be concurrently associated with more negative parenting behaviors related to disciplinary practices (OPS Total) as well as reactive responses to child negative emotions (CCNES Reactions). As hypothesized, more problems with emotion regulation were significantly associated with parents reported more negative disciplinary behaviors (lax and overreactive; OPS), which remained significant when holding child behavioral severity constant. It was hypothesized that the interaction of child behavioral severity and parent problems with emotion regulation would also we significantly associated with negative parenting, but this result was not supported. Parent ER was positively correlated with CCNES Reactions but was not significantly associated with CCNES Reactions after a significant outlier was removed from regression analyses. The hypothesis that the interaction between parent ER and child behavioral severity would be significantly associated with CCNES Reactions was also not supported by these results. Parent executive function was not concurrently associated with negative parenting disciplinary behaviors (OPS) nor reactive responses to child negative emotions (CCNES Reactions), as such these findings did not support hypotheses.

Aim 2 and 3 – Fundamental Frequency during Dyadic Observations

All other analyses were conducted in SAS 9.4 (SAS Institute Inc, 2013) using a multilevel modeling (MLM) approach with PROC MIXED to account for nonindependence in data caused by nesting of individuals within family dyads and talk turns within individuals. All MLMs will be conducted as two-intercept models for distinguishable dyads, which are a variation of multivariate MLMs (Kenny et al., 2006) and result in separate estimates for parents and children while accounting for nesting in the data. See Table 3 in Appendix F for APIMs results.

First, differences in aggregate arousal were compared for both observations and for each individual in the dyad. Next, coregulation of emotional arousal during the parent-child interaction tasks were modeled in two ways, in accordance with relevant recommendations (Butler & Randall, 2013) and previous research (Fischer et al., 2017; Fischer et al., 2022; Soma et al., 2020; Weber et al., 2019). 1) Cross-lagged actor–partner interdependence models (APIMs; Kenny et al., 2006) tested coregulation of emotional arousal across the interaction as indicated by the cross- partner effects. 2) Coupled linear oscillator (CLO) models (Boker & Laurenceau, 2006) examined the influence of individuals' (e.g., parent) f_0 on the oscillatory trajectory of f_0 in the other individual (e.g., child). Random intercepts for parent and child were separately estimated for all models. Parent emotion regulation, executive function, and child ADHD were added as interaction terms in all three analyses.

Difference in Aggregate Emotional Arousal

All hypotheses were tested using two-intercept multilevel models following procedures and specification outlined by Campbell and Kashy (2002). Following these recommendations, the nonindependence in the data was accounted for by treating the scores for parents and children within each family as repeated measures (compound symmetry specification). As such, separate intercepts were estimated for parents and children, and interaction terms with the intercepts were added for hypothesis-specific variables of interest. This approach facilitated simultaneously testing the differences in f_0 mean for parents, which were the focus of the hypotheses, along with differences for children for explanatory purposes. Due to small sample size, separate models were tested for each predictor (parent self-regulation, child ADHD) for both observed interactions (clean up task and delay gratification task).

Parent emotion regulation. Parents with more problems with emotion regulation were expected to show greater aggregate emotional arousal than parents with less severe problems with emotion regulation. The hypothesis was tested by including an interaction term for each intercept with the grand-mean centered variable for emotion regulation problems (DERS). There was no support for this hypothesis. The model indicated that the aggregate f_0 mean values did not vary depending on the parent's DERS score for parents (Clean Up task: $\beta = 0.14$, $SE = 0.15$, $p = 0.35$; Delay Gratification Task: $\beta = 0.11$, $SE = 0.16$, $p = 0.50$) or children (Clean up task: $\beta = 0.06$, $SE = 0.31$, $p = 0.84$; Delay Gratification Task: $\beta = -0.383$, $SE = 0.30$, $p = 0.20$).

Parent executive function. Parents with more problems with executive function were expected to show greater aggregate emotional arousal than parents with less severe problems with executive function. The hypothesis was tested by including an interaction term for each intercept with the grand-mean centered variable for executive function problems. There was partial support for this hypothesis. The model indicated that the aggregate f_0 mean values did not vary depending on the parent's BRIEF GEC score for parents (Clean Up task: $\beta = 0.15$, $SE = 0.13$, $p = 0.27$; Delay Gratification Task: $\beta = 0.03$, $SE = 0.14$, $p = 0.84$). However, children's aggregate f_0 mean was greater for dyads with higher parent-reported problems with EF for the clean-up task ($\beta = 0.54$, $SE = 0.27$, $p = 0.05$) but there was no significant relationship identified during the Delay Gratification Task ($\beta = -0.21$, $SE = 0.27$, $p = 0.44$).

Child ADHD diagnosis. The child ADHD diagnostic group was dummy coded (ADHD = 1, no ADHD= 0). Differences between the ADHD and non-ADHD group in aggregate levels of emotional arousal across the interactions were tested using two-intercept MLMs. There was partial support for this hypothesis. For the clean-up task, parents with a child who has ADHD did not have significantly higher aggregate f_0, emotional arousal, during the interaction (β = 5.48, *SE* = 6.06, *p* = 0.371). The difference in aggregate emotional arousal approached significance for children who have ADHD during the clean-up task (β = 23.32, *SE* = 12.21, *p* = 0.063). In the delay gratification task, there was no support for any differences in aggregate emotion arousal for parents (β = 6.19, *SE* = 6.37, *p* = 0.336) or children (β = 7.71, *SE* = 12.27, *p* = 0.533).

Covariance: Cross-Lagged Actor-Partner Interdependence Models

The data were analyzed using change-as-outcome, actor-partner interdependence models (APIMs; Kenny et al., 2006; Perry et al., 2017) using PROC MIXED in SAS 9.4 (SAS Institute Inc., 2013). See Table 5 for APIM results. Change-as-outcome APIMs estimate actor and partner effects from the previous talk turn to the next talk turn. For both the parent and the child, their f_0 mean at a given talk turn i is predicted by their own f_0 mean at their previous talk turn i-1 (actor effects) and the other person's f_0 mean at their immediately preceding talk turn i-1 (partner effects). Parent ER, parent EF, and child ADHD were added separate models as level-2 predictors and the cross-level interaction between these predictor variables and partner effects for both children and parents were the focus of analyses. The following equations describe these models where i indexes talk turns and j indexes parent-child dyads, with parent ER as an example predictor variable:

Level-1:

$$f_0mean_{ij} = Parent * \left[\beta_{1j}(intecept) + \beta_{3j}\left(actor_{f_0mean_{(i-1)j}}\right) + \beta_{5j}\left(partner_{f_0mean_{(i-1)j}}\right)\right]$$

$$+Child * \left[\beta_{2j}(intecept) + \beta_{4j}\left(actor_{f_0mean_{(i-1)j}}\right) + \beta_{6j}\left(partner_{f_0mean_{(i-1)j}}\right)\right] + r_{ij}$$

Level-2:

$$\beta_{ij} = \gamma_{i0}(intercept) + \gamma_{i1}(parent\ problems\ with\ ER)$$

Clean up task APIMs. In the base APIM without additional predictors, both parents (β = -0.869; p < 0.0001) and children (β = -0.915, p < 0.0001) showed significant and negative actor effects, meaning that they showed significant intraindividual regulation back toward their baselines after being perturbed at the previous talk turn, indicating evidence of a self-regulatory system as expected. Only parents (β = 0.061, p < 0.0001) but not children (β = 0.021, p = 0.6918) had a significant positive partner effect, showing significant covariation with child's arousal at previous talk turn. Meaning that parent's emotional arousal tended to increase following their child's emotional elevation relative to his/her baseline. When DERS was added as a moderator, there were no significant interaction effects with partner or actor effects for either parents or child. When BRIEF GEC was added as a moderator, there were no significant interaction effects with partner or actor effects for either parent or child. Then, when ADHD diagnosis was added as a moderator, there were no significant interaction effects with partner or actor effect for either parent or child.

Delay gratification task APIMs. In the base APIM without additional predictors, both parents (β = -0.8247, p < 0.0001) and children (β = -0.8466, p < 0.0001) showed significant and negative actor effects, meaning that they showed significant intraindividual regulation back toward their baselines after being perturbed, as would be expected for a homeostatic conceptualization of emotional arousal. Both parents (β = 0.06121, p = 0.0002) and children (β = 0.1034, p = 0.04) had a significant, positive partner effect, showing significant reactivity to the other individual's arousal. When DERS was added as a moderator, there were no significant interaction effects with partner or actor effects for either parents or child. When BRIEF GEC was added as a moderator, there were no significant interaction effects with partner or actor effects for either parent or child. Then, when ADHD diagnosis was added as a moderator, there were no significant interaction effects with partner or actor effect for either parent or child.

Summary of covariance APIMs models results. Parents' change in emotional arousal was significantly associated with their child's emotional arousal, relative to their baseline, at the previous talk turn for both the Clean Up task and the Delay Gratification task. Children only demonstrated covariance with their parent's emotional arousal in the Delay Gratification task but not the Clean Up task. Of note, these differences should be interpreted with caution as tasks differences and differences in actor and partner effects for each individual were not directly tested. Contrary to all hypotheses related to parental self-regulation variables and child ADHD, there were no differences in coregulation through the lens emotional arousal covariation associated with problems with parent ER, EF, or any differences between children with versus without ADHD.

Coupling: Coupled Linear Oscillator Models

Coupled linear oscillator (CLO) models (Boker & Laurenceau, 2006) examined the influence of a parent's f_0 on the oscillatory trajectory of their child's f_0 and vice versa. Coupling refers to associations of the dynamic characteristics of each individual's self-regulating system of emotional arousal (see Boker & Laurenceau, 2006; Story & Butner, 2010). These models draw on each actor's self-regulation patterns that cycle up and down around an emotional baseline. While the APIMs models assessed the covariance of emotional arousal from one talk turn to the next, CLOs examine the curvature of each individual's trajectory of emotional arousal over an interaction. For example, the extent to which an individual's current level of arousal is displaced from their baseline is associated with the rate of change in arousal and how quickly arousal returns to baseline after perturbation. If a partner's emotional arousal is high, relative to their own baseline, this may keep the actor's emotional arousal elevated longer than would be predicted by that individual's pattern of emotional regulation. When there are cross-partner influences in the shape of regulatory patterns, then it is described as "coupling." When individuals become more aroused (i.e., move further from their baseline) the pull to return back to that baseline becomes stronger. These patterns of self-regulation will be quantified by the rate that the slope of arousal changes (i.e., acceleration) and the distance from baseline (i.e., amplitude). The acceleration of this trajectory refers to the shape of an individual's arousal and regulation trajectory over time. Further, it is of interest if the peak is reduced over time for an individual, showing a dampening pattern. This pattern of diminished emotional reactivity is quantified by the association between acceleration and velocity of the wave at any time point. Multilevel coupled linear oscillator models were used, for the purpose of assessing coregulation in this study. The basic level-1 equation for patients is

$$\ddot{x}_{ij} = \eta_{ix}x_{ij} + \zeta_{ix}\dot{x}_{ij} + \eta_{iy}y_{ij} + \zeta_{iy}\dot{y}_{ij} + e_{ij}$$

where $\ddot{x}_{ij}$ is the second derivative (acceleration; rate of change of slopes, or curvature) of emotional arousal of parent i on talk turn j, x_{ij} and $\dot{x}_{ij}$ are the displacement from the equilibrium and first derivatives (slope, rate of change in f_0) for parent with their respective coefficients. The following two terms are the same terms for the children, and the coefficients η_{iy} and ζ_{iy} indicate the degree to which the child's displacement from their equilibrium (y_{ij}) and their rate of change in displacement ($\dot{y}_{ij}$) influences the parents' second derivative of emotional arousal, that is, the degree to which coregulation as coupling occurs for the parent. It is assumed that self-regulation would occur in these models, represented by η_{ix} being negative and significant. The influence of the partner's displacement from equilibrium is the main focus of the current study to determine coupling, represented by η_{iy}. The dampening parameters ζ estimate whether the oscillations of an individual decrease in amplitude across time and how this might be influenced by the partner's regulation. To test the hypotheses of parent self-regulation variables and child ADHD effecting these parameters, the level-2 equations of the multilevel model were extended as they were in the APIMs. This results in cross-level interactions with the coupling parameters discussed above to examine differences by ADHD diagnostic group and parental self-regulation EF and ER severity.

Preliminary analyses and estimation of derivatives. First and second-order derivatives for each time series were estimated using local linear approximation (LLA) estimates (Boker & Laurenceau, 2006; Boker & Nesselroade, 2002). Consistent with previous studies that have used LLA with f_0 data (Fischer et al, 2017; Fischer, et al., 2022; Baucom, et al., 2012), LLA was chosen as an adequate method to estimate derivatives using a lag of τ=1 talk turn. Linear trends were removed before estimating derivatives and detrending was completed by fitting a slope and intercept model to each time series and then saving the residuals for use in the following analyses. Then, the first and second derivatives were estimated using LLA (Boker & Laurenceau, 2006).

Simple coupled linear oscillator models without level-2 predictors were analyzed for each observation (clean up, delay gratification) and for both parents and children, including random effects for each person's own and partner's displacement from equilibrium, estimating the variances for each effect but not covariances. The fixed effects for self-regulation (effects of one person's displacement from equilibrium on their second derivative) were negative and significant for parents (Clean up: η = -1.93, $t(2207)$ = -34.83, $p < 0.0001$; Delay gratification: η = -1.95, $t(2204)$ = -28.3, $p < 0.0001$) and children (Clean up: η = -2.05, $t(2207)$ = -30.66, $p < 0.0001$;

Delay gratification: η = -2.00, $t(2204) = -28.7$, $p < 0.0001$). These findings are necessary to interpret CLO models because they indicate the presence of self-regulatory processes.

Next, hypotheses focusing on the coupling aspect of coregulation were tested, adding hypothesis-specific level-2 predictors to the CLO models. For each model, interaction terms were created for the predictors with the effects for the parents' and children's displacement from equilibrium were included as random effects, which increased the number of variance parameter estimates to 5 for each model.

Clean up task CLOs. Significant negative associations emerged for one person's own f_0 at previous talk turn for both children (η = -2.05, t = -30.66, $p < 0.0001$) and parents (η = -1.93, t = -34.83, $p < 0.0001$). This indicates that when f_0 was father away from baseline individuals returned to baseline faster subsequently, confirming the self-regulatory component of the oscillator models. Thus, the coupled effects can be interpreted as the influence of the other's arousal on these fluctuations beyond the form they would take for the parents alone. This effect was not moderated by parent ER problems for parents (η = 0.002, t = 0.74, p = 0.46) or children (η = -0.001, t = -0.19, p = 0.85). This effect was also not moderated by parent EF problems for parents (η = 0.003, t = 1.08, p = 0.28) or children (η = -0.004, t = -1.23, p = 0.22). Lastly, this effect was also not moderated by child ADHD diagnosis for parents (η = 0.027, t = 0.23, p = 0.81) or children (η = 0.146, t = 1.05, p = 0.293).

In the model before level-2 predictors were added, coupled effect of child's f_0 displacement from equilibrium on parent's curvature of emotion arousal regulation system was not significant (η = -0.002, t = 0.07, p = 0.947). However, significant positive associations emerged for children's acceleration back to baseline and their parent's f_0 at the previous talk turn (η = 0.229, t = 0.21 p < 0.0001). This indicates that when parent's f_0 was farther away from their baseline (more emotional aroused than usual), children's f_0 subsequently returned to baseline more slowly or was pulled in the direction of their parent's displacement from equilibrium. These associations with the other person's f_0 at last talk turn were not significantly moderated by parent reported problems with ER for parents (η = 0.001, t = 0.93, p = 0.350) or children (η = 0.001, t = 0.25, p = 0.80). Neither were these associations significantly moderated by parent reported problems with EF for parents (η = 0.001, t = 0.54, p = 0.589) or children (η = -0.002, t = -0.57, p = 0.567). For dyads with a child with an ADHD diagnosis, parents *were* significantly more influenced in their regulation of emotional arousal by their child's displacement from their equilibrium (η = 0.128, t = 2.80, p = 0.005). The positive direction of the effect indicates a "pull" of the child's emotional arousal on the parent's curvature in the direction of the child's displacement from equilibrium. As such, if both parent and child are displaced from their equilibrium in the same direction (above or below), then it would be expected that parents would return to baseline more slowly than they would if they were unaffected by their child's emotional arousal. The association between children's acceleration back to baseline and the magnitude of their parent's f_0 displacement from baseline was not moderated by child ADHD diagnosis, meaning that there was a significant coupling effect of parents on children's return to baseline in both ADHD and non-ADHD groups (η = 0.045, t = 1.31, p = 0.759).

Dampening effects: Effects based on actor and partner slope of f_0. There were no significant associations between either parent's (η = 0.013 t = 0.24, p = 0.809) or child's (η = 0.012, t = 0.22, p = 0.824) acceleration back to baseline and their own most recent rate of change in arousal (i.e., no intrinsic dampening effect). There was also no significant association between either parent's (η = 0.025 t = 0.83, p = 0.41) or child's (η = 0.114 t = 1.14, p = 0.253) acceleration back to baseline and the other person's most recent rate of change in arousal. There was a trend-level (p = 0.08) moderation effect of parent problems with ER (DERS) and parent's f_0 slope on children's curvature, indicating that there may be an opposite dampening effect such that the children's curvature is predicted to respond positively to change in parent's displacement from equilibrium which results in an increase in magnitude of children's oscillations over time as a function of increased parent-reported emotion dysregulation (η = 0.010, t = 1.74, p = 0.08). There was no moderation with parent ER on the dampening effect on parent f0 curvature associated with child's f0 slope (η = 0.000, t = 0.29, p = 0.775). These effects were not moderated for either parents (η = 0.001, t = 0.56, p = 0.578) or children (η = 0.007, t = 1.48, p = 0.140) based on parent problems with EF. Finally, there was no moderation on effect of partner f_0 slope with child ADHD diagnosis for either parents (η = 0.006, t = 0.09, p = 0.925) or children (η = 0.314, t = 1.53, p = 0.127).

Delay gratification task CLOs. Significant negative associations emerged for one person's own f_0 at previous talk turn for both children (η = -2.00, t = -28.3, p < 0.0001) and parents (η = -1.95, t = -28.3, p < 0.0001). This indicates that when f_0 was further away from baseline individuals returned to baseline faster subsequently, confirming the self-regulatory component of the oscillator models. Thus, the coupled effects can be interpreted as the influence of the other's arousal on these fluctuations beyond the form they would take for the parents alone. Parent ER did not moderate this effect for parents (η = 0.003, t = 0.90, p = 0.368) or children (η = 0.003, t = 0.71, p = 0.477). This effect was also not moderated by parent EF problems for parents (η = -0.001, t = -0.35, p = 0.727) or children (η = 0.001, t = 0.25, p = 0.80). Lastly, this effect was also not moderated by child ADHD diagnosis for parents (η = 0.163, t = 1.09, p = 0.274) or children (η = -0.114, t = -0.77, p = 0.439).

In the model before level-2 predictors were added, coupled effect of child's f_0

displacement from equilibrium on parent's curvature of emotion arousal regulation system was not significant (η = 0.023, t = 0.96, p = 0.335). However, significant positive associations emerged for children's acceleration back to baseline and their parent's f_0 at the previous talk turn (η = 0.148, t = 2.15, p = 0.032). This indicates that when parent's f_0 was farther away from their baseline (more emotional aroused than usual), children's f_0 subsequently returned to baseline more slowly or was pulled in the direction of their parent's displacement from equilibrium. Parent-reported problems with ER did not moderate these associations with the other person's f_0 at last talk turn for parents (η = -0.001, t = -0.40, p = 0.688) or children (η = -0.003, t = -0.74, p = 0.461). Parent reported problems with EF did not significantly moderate these associations for parents' curvature (η = 0.000, t = 0.02, p = 0.987) or children's (η = 0.005, t = 1.49, p = 0.138). The association between children's acceleration back to baseline and the magnitude of their parent's f_0 displacement from baseline was not moderated by child ADHD diagnosis, meaning that there was a significant coupling effect of parents on children's return to baseline in both ADHD and non-ADHD groups (η = -0.064, t = -0.041, p = 0.679). The association between parent's coupling with child f_0 at last talk turn was not significant for either ADHD or non-ADHD group, meaning that there was no significant moderation with child ADHD diagnosis (η = 0.018, t = 0.33, p = 0.743).

Dampening effects: Effects based on actor and partner slope of f_0. There were no significant associations between either parent's (η = 0.045, t = 0.82, p = 0.411) or child's (η = 0.002, t = 0.03, p = 0.973) acceleration back to baseline and their own most recent rate of change in arousal (i.e., no intrinsic dampening effect). There was also no significant association between either parent's (η = 0.010 t = 0.32, p = 0.752) or child's (η = -0.048, t = -0.52, p = 0.605) acceleration back to baseline and the other person's most recent rate of change in arousal. There was no moderation with parent ER on the dampening effect of parent f_0 on child oscillation curvature (η = -0.003, t = -0.57, p = 0.857). There was no moderation with parent ER on the dampening effect on parent f_0 curvature associated with child's f_0 slope (η = -0.01, t = -0.45, p = 0.653). These effects were not moderated for either parents (η = 0.002, t = 1.06, p = 0.287) or children (η = -0.001, t = -0.26, p = 0.795) based on parent problems with EF. Finally, there was no moderation on effect of partner f_0 slope with child ADHD diagnosis for either parents (η = 0.010, t = 0.14, p = 0.890) or children (η = 0.133, t = 0.65, p = 0.514).

Summary of Coupling Coregulation Results based on CLO Models. During both the clean-up and delayed gratification tasks, children's emotional arousal patterns coupled with their parent's patterns of emotional arousal. Thus, when parents' emotional arousal was elevated relative to their baseline (i.e., more emotional than they usually are), then children's emotional arousal regulated more slowly as they were pulled in the direction of their parent's emotional arousal. This pattern was not significantly altered when predictor variables (e.g., parent EF, parent ER, and child ADHD) were added to the model. Conversely, parents did not show significant coupling with their children during the clean-up task. This pattern was not significantly changed when the parental self-regulation variables were added to the models (e.g., parent EF, parent ER). However, parents of children with ADHD did show significantly more coupling with their children than parents of children without ADHD, during the clean-up task but not the delay gratification task.

CHAPTER 4: DISCUSSION

This study examined correlates of parental self-regulation on parenting and parent-child relationships at two levels of analysis in a sample of young children with clinically significant problem behavior. Associations with parent emotion regulation and executive function with globally reported negative parenting behaviors as well as moment-to-moment patterns of parent-child emotion dynamics were tested. This study contributes to our understanding of typical patterns of emotional arousal and coregulation during interactions with parents and children with disruptive behaviors and contrasts these patterns for families of children with comorbid ADHD. Both covariation and coupling of vocally-encoded emotional arousal were used as indicators of emotion coregulation from a dynamic systems perspective, providing a nuanced view of the interpersonal system and opportunity to explore the specific role of parent-self regulation and child ADHD.

Interpretation of Findings - Parent Self-Regulation on Negative Parenting Behaviors

The current study examined the unique associations between parent self-regulation constructs and negative parenting behaviors associated with early childhood disruptive behavior. The results of this study indicated that parents with greater global emotion dysregulation reported more negative disciplinary behaviors. This finding is consistent with the broader literature theoretically pointing to negative parental emotional arousal and distress increasing parent's vulnerability toward negative parenting practices (Gudmundson & Leerkes, 2012; Lorber et al., 2016; Lorber & Slep, 2005; Mence et al., 2014) however specific empirical comparisons are confounded by varying constructs associated with parent emotion regulation, child age, and clinical characteristics of sample. This finding supports previous empirical research showing a relationship with negative parenting behaviors among mothers in a community sample that including ADHD as well as non-clinical participants (Woods et al., 2019). Other studies have found an association with parent-reported use of emotion regulation strategies such as cognitive reappraisal and emotional suppression with observed negative parenting in this age range for non-clinical samples (Deater-Deckard et al., 2016; Kohlhoff et al., 2016) and among parent-toddler dyads (Lorber, 2012; Rodriguez et al., 2017). These findings fit with evidence showing that parents of children with clinically significant behavioral problems report greater emotion dysregulation (Quetsch et al., 2018). Although there was no evidence for the hypothesis that child behavioral severity moderated the relationship between parent emotion dysregulation and negative parenting behaviors, despite child behavior being consistently acknowledged as an important determinant of parenting behavior (e.g., Belsky 1984). This may be due to child behavioral severity being part of the eligibility criteria for participation in the study, which might have limited the variability needed to detect this effect.

Results did not support the hypothesis that parent emotion dysregulation was associated with unsupportive reactions to child negative emotions. This is surprising in light of other studies identifying this effect for specific aspects of emotion regulation, such as use of ER strategies (Jaffe et al., 2010; Morelen et al., 2016; Shaffer et al., 2016) but consistent with Woods and colleagues (2021) and Highlander and colleagues (2021) who similarly did not find significant associations when using a total scale of emotion dysregulation (see Zimmer-Gembeck et al., 2022 for meta-analysis). This suggests that specific skills associated with emotion regulation such as use of cognitive reappraisal or emotion suppression strategies (Lorber, 2012; Lorber et al., 2016; Shenaar-Golan et al., 2017) may be particularly important for emotion-related parenting behaviors, including minimizing, punishing, or becoming distressed in response to child negative emotions (Eisenberg et al., 1998). There is also significant support for emotion regulation being positively associated with supportive emotion socialization behaviors (Morelen et al., 2016; Shaffer & Obradovic, 2016; Highlander et al., 2021) indicating that there is likely a relationship between parent emotion regulation skills and their emotion socialization behaviors with their children, but it may be better characterized by withdrawal from supportive emotion coaching (i.e., reduction in supportive behaviors) rather than necessarily an escalation in negative behaviors for parents of children with disruptive behaviors disorders. Nuanced profiles of emotion socialization styles including both supportive and unsupportive characteristics in relation to identified determinants of parenting, child characteristics, and parent self-regulation constructs would assist with further theoretical development of child emotion socialization processes and provide a better understanding of risk and resilience toward externalizing child psychopathology (see Hajal & Paley, 2020 for theoretical review).

The current study did not find evidence to support the hypothesis that parental executive dysfunction is associated with negative parenting behaviors or unsupportive emotion socialization. The lack of support for parental EF relating to negative disciplinary practices is surprising given the many reviews positing this association (e.g., Bridgett, et al., 2015; Crandall, et al., 2015; Rutherford et al., 2015). However, many of these studies used laboratory-based measures of EF and focused on a specific aspect of EF, such as working memory (Deater-Deckard, et al., 2010; Sturge-Apple et al., 2014), whereas the current study used parent-self report of composite executive dysfunction. Global self-report measures are important indicators of EF-related impairment in the context of every day stressors across a variety of contexts associated with EF, which is why a self-report measure was used in the current analysis which differentiates these results (see Toplak et al., 2013for consideration of how self-report and performance measures may diverge). One other study used the BRIEF-A to examine correlates with parent-reported factors associated with child abuse risk and found that working memory, emotional control, and cognitive flexibility were significantly associated but surprisingly not inhibition (Crouch et al., 2019). It may be the case that some of these specific EFs but not others are most closely associated with negative parenting behaviors, consistent with research using laboratory-measured EF constructs reviewed above. It may also be the case that parents' report of their EF skills in contexts outside of interactions with their child are not as closely related to their parenting, especially given the challenging nature of parent-child interactions with children with BDs.

Indeed, an additional distinguishing factor to this current study in relation to others is the application in a clinically-significant BD sample. Previous research found that the relationship between parental working memory and harsh parenting was only held in the context of low household chaos (Deater-Deckard et al., 2012), which suggests that samples where stress is high may not identify the association between cool EF and harsh parenting. The lack of association found in the current study may be another example of greater parental stressors – in this case, significant child problem behavior – minimizing associations between executive dysfunction and negative parenting behaviors. Parent-reported stress specifically associated with their child's behavior was not measured here, but future research should continue to investigate the role of parenting stress on parental self-regulation and negative behaviors. Moreover, how challenges caused by their child's misbehavior, versus other factors of environmental adversity, may contribute to different parental attributions and emotional impact.

Interpretation of f_0 results

Emotion coregulation dynamics were assessed by measuring the presence or degree to which parents and their children showed emotional covariation and coupling during two unique interactions. In both covariation and coupling, each individual's actor effects, or the influence of their own emotional arousal at the last talk turn, and the partner effects caused by their partners arousal while controlling for their actor effect, were estimated although partner effects were of particular interest in the current study. Covariation partner effects could be conceptualized as interpersonal reactivity, as they measure the immediate influence of one person's emotional arousal on the other person's subsequent arousal. Coupling partner effects are more in line with coregulation or co-dysregulation, like an upward or downward spiral emotionally. Observational assessment of parental emotions, such as vocally-encoded emotional arousal (f_0), is useful because it represents emotional information that is conveyed to the child, unlike psychophysiological measures that are not socially transmitted like respiratory sinus arrhythmia (RSA). As such, our observations are based on *expressed* emotional arousal.

It was hypothesized that parents of children with ADHD would exhibit higher levels of emotional arousal as well as differences in coregulation (i.e., covariance and coupling) compared to families of children with disruptive behaviors without ADHD. Regardless of ADHD status, it was expected that indicators of coregulation and aggregate emotional arousal would vary by parent executive dysfunction and emotion dysregulation. Child emotional arousal and coregulation were examined to provide context for hypotheses about parent emotional functioning in observations with their child, including associations with parent self-regulation variables and child ADHD status. Finally, these analyses were done for two distinct parent-child observation tasks wherein a parent is asked to complete a challenging task with their child, directing their child to clean up a mess of toys they did not make and completing an administrative task while responding to their child in a room without toys and visible cookie that the child is not allowed to access for five minutes.

Across both tasks, neither parent difficulties with ER or EF was significantly associated with covariation or coupling. Parent difficulties with EF was associated with *child* aggregate emotional arousal for the clean-up task, but not delay gratification task. Neither parent self-regulation variable (EF or ER) was associated with *parent* aggregate emotional arousal, as hypothesized. However, parents of children with ADHD compared to parents of children without ADHD showed significantly more emotional coupling with their children's emotional arousal for the clean-up task. No differences between groups were found for emotion covariation in either task.

Patterns of emotional arousal covariation and coupling between parents and children

Before adding predictor variables, the emotion dynamics for this sample showed that parents' intraindividual emotion regulation significantly covaried with their children during both tasks, whereas children only covaried with their parents on the delay gratification. The effect was reversed from a coupling perspective, where children, but not parents, showed changes in their overall emotion regulation patterns as a function of parent's emotional arousal, meaning that parent's emotional arousal worked like a magnet to slow children's regulation back to baseline after being perturbed. During the clean-up task, children's level of emotional arousal influenced their parent's emotional arousal from one talk turn to the next, but the relationship was not bidirectional as children did not match their parent's arousal from one talk-turn to then next. So, it may be that children emotionally reacted to the clean-up task regardless of parent's emotional arousal since parents are directing them to clean up and the task alone contributes to their frustration. In turn, parents reacted to their children's arousal by immediately becoming more emotionally aroused. Children's emotional arousal was differentially influenced by their parents, with children taking longer to regulate (even based on their own intraindividual pattern of regulation) when their parent expressed more emotional arousal. This might be because children are already frustrated during a clean-up task (regardless of parent emotions) and become even more upset when their parent gets upset with them. This broadly resembles the interpersonal dynamic that would be expected when children with externalizing problems are given a compliance task, where they may refuse or argue which in turn escalates their parent's frustration (e.g., Burke et al., 2008; Smith et al., 2014; Snyder, 2016). Without a typically-developing reference group, it is unclear how this pattern may vary based on childhood BD symptomatology. Nonetheless, these findings suggest that children with BDs in the current sample are sensitive to the emotional arousal of their parents, to the extent that they remain distressed for longer based on how emotionally aroused their parents become.

Covariation refers to bidirectional linkages of levels of emotional arousal between parent and child over the course of an observation. In this sample, parents' level of expressed emotional arousal was influenced by their children in both clean up task and delayed gratification, but children's emotional arousal was only influenced by their parent's emotional arousal in the delay gratification task. This may be due to the interactive nature of the delay gratification task, which does not explicitly give a behavioral task for the child beyond coping with not having a cookie presented to them and therefore provided an opportunity for open conversation between dyads. In the clean-up task, children might have had variable emotional reactions to the content of what their parents were saying to them (i.e., being told directly to clean up toys) and the emotional-tone of their parent's directions was less impactful to the overall experience.

Lack of Association between f_0 Dynamics and Parent-Report of Emotion Regulation

This study did not find any emotional-arousal associations with DERS scores. While this was a moderately small sample, it is strange for parent-reported problems with emotion regulation to have so little association with overall arousal or regulation patterns for parents. The DERS captures subjective, trait-like emotion regulation characteristics from the parent's perspective of their own functioning averaged across all areas of their life. In contrast, fundamental frequency captures objective emotional arousal that is *vocally expressed* in the context of a parent-child interaction. These measures seem to be representing different constructs related to emotion and emotion regulation and there are a few possible explanations for this lack of association.

There may be an important difference in emotional experience, reactivity, and regulation in response to a parenting task than a parent would report about other areas of their life, such as emotion regulation at work or in the context of other interpersonal relationships. The parents in this sample may vary based on how regulated and effective they are in all other domains of their life (as these areas were not the basis of this study), but what they have in common is difficulty managing their child's significantly disruptive behaviors. Coercion theory posits that there is a downward spiral in emotional intensity and negativity over time because both parent and child become behaviorally and affectively shaped to escalate more quickly during conflict based on the evolving intensity of prior interactions (e.g., Dishion & Patterson, 2006; Dishion, Patterson, & Kavanagh, 1992; Patterson 1976; 1982). As such, the degree to which parents respond to their child's expressed emotion during these tasks may be unique to how parents experience their emotions outside of similar tasks. Evidence emerging that parental emotions and emotion regulation processes may be distinct from other contexts in their lives (Rutherford et al., 2015;

Teti & Cole, 2011; Hajal & Paley, 2020) because of the unique circumstances in a relationship in which “one person is responsible for the emotional well-being of the other” (page 413, Hajal & Paley, 2020). For example, anger is generally established as an approach-oriented emotion (Carver & Harmon-Jones, 2009) but in a study of mothers of 14-24 month-olds engaging in a challenging parental task, parents self-reported anger was associated with an urge to disengage from the interaction. This reverse in emotion-oriented urge in the context of parenting may reflect an automatic emotion regulation process that is specific to parenting young children (Hajal et al., 2019).

Moreover, expressed vocally-encoded emotional arousal would theoretically be a result of an individual’s immediate emotional reactivity followed by potentially some degree of emotional modulation or potentially suppression, especially in relation to their children. Emotion response modulation is one of the five emotion regulation processes described by the Gross/Thompson model of emotion regulation and it refers to one directly influencing experiential, expressive, and/or physiological responses associated with emotion (Gross & Thompson, 2007). Emotion suppression is a form of this process and may be illustrated by an angry parent making efforts to relax their face or voice and conceal their frustration from their child. Experiments have shown the distinct effects of emotional suppression on expressive, experiential, and physiological components of emotion such that suppression reduces facial expression but not the internal experience of negative emotion (Gross 2011) and may even result in greater physiological responses (e.g., Roberts, Levenson, & Gross, 2008). The role of emotion modulation is unclear without eliciting feedback from parents about their emotions during a task retroactively, which may have limited validity. Using self-report measures about specific emotion regulation strategies in addition to objective measurement of fundamental frequency may clarify these intrapersonal mechanisms.

F_0 Associations with Parental ER and Child ADHD during the Clean Up Task

Despite emerging literature indicating that parental problems with EF, particularly working memory, is associated with harsh and overreactive parenting (Deater-Deckard et al., 2010, 2012; Sturge-Apple et al., 2014, 2017), the current study did not find any associations with intrapersonal or interpersonal emotion regulation. Although this lack of evidence is consistent with some similar findings associated specifically with verbally-based parenting outcomes, including Crandall and colleagues (2018) who did not find an association between maternal executive function and maternal harsh *verbal* parenting using a sample of parents with children in the same age-range as the current study. Chen and Johnston (2007) also found that deficits in EF were related to inconsistent discipline but not to parental over-reactivity, which included various items related to parents' inclination to yell at their children. Difficulty with consistency in behavioral expectations across time would be expected of an individual with more difficulties with EF, verses ER, due to noted impairments in planning, set shifting, and awareness of time (see Barkley 2011). Parents with greater difficulties with EF have been found to create less structure at home (Deater-Deckard et al, 2012), organize fewer enriching activities (Korucu et al., 2020) and struggle with scaffolding and teaching their children difficult tasks (Mazursky-Horowitz et al., 2018). These findings may provide context to interpret the elevated aggregate emotional arousal for *children* of parents with greater EF problems during the clean up task.

The clean-up task asked parents to imagine they were late for an important appointment and they needed their child to clean up their toys before leaving by sorting four different types of toys strewn around a small room into four separate bins, labeled by a picture of the type of toy.

Parents were to direct their child to pick up and sort the toys but not to touch the toys themselves. It is not expected that the task itself was too challenging for parents to organize, but it may be that parents with greater EF-related problems do not practice tasks like this as often with their children. Directing young children in a compliance task requires clear communication followed by patience in response to the length of time a child may take to do a task versus a parent doing it for them. Resisting the urge to do a task, such as cleaning up, for a child requires inhibition and keeping in mind the long-term importance of children learning these skills. In the moment, parents with greater EF-related problems may be more inclined to value to benefit of moving through the task over future benefits, due to delay time-discounting tendencies associated with executive dysfunction (Dassen et al., 2018; Prencipe et al., 2011).

Lastly, adults with EF-related problems often report problems with time management and disorganization (indeed these items are measured on the BRIEF-A), which may limit the opportunity for children to have the time and structure needed to scaffold the development of household tasks like cleaning up and may also contribute to parents cleaning up for their child. During the same clean up task, there was also a trend ($p < 0.07$) toward children with ADHD having greater aggregate arousal as well as child ADHD and parent EF was moderately correlated in this study. The slightly different and unique effects from parent and child characteristics may indicate an additive effect. ADHD is a very heritable condition (0.88; Larsson, et al., 2014) so it is not surprising that about half of all children with ADHD have at least one parent who meets diagnostic criteria as well (Johnston, et al., 2012).

Parents of children with ADHD, however, did show significant coupling with their child. They were significantly slower to regulate their emotions following their child's elevated emotional arousal in the clean-up task. This slower return to baseline relative to parents of children without ADHD might indicate that their emotional arousal is fluctuating in a less consistent way. This effect may be due to children with ADHD having higher aggregate arousal throughout the task than children without ADHD suggesting that parents may be more vulnerable to dysregulation relative to their own intraindividual regulation patterns with children who express more emotional arousal, based on the assumption that self-regulation resources are limit and can become depleted (Baumeister et al., 2007; Muraven et al., 1998). Five minutes of clean up may be most challenging for kids with ADHD as children with ADHD in this age range can have significantly delayed EF (e.g., Barkley et al., 2001; Karalunas et al., 2018; Lambek et al., 2018; Tripp & Wickens, 2009). This clean up task may have been a lot more difficult for kids with ADHD, due to specific underlying instrumental learning deficits which require specific enhancements to BPT, as has been argued elsewhere (Sonuga-Barke, et al., 2018; van der Oord & Trip, 2020; Dekkers, et al., 2022). Specifically, children with ADHD have increased variability in their responding (Kaminski, et al., 2008), which results in more lapses in attention during a task, and atypical motivational processes in comparison to children with DBDs (Luman, et al., 2010; Lundahl, et al., 2006). Johnston and Mash (2001) observed that children with ADHD expressed greater emotional intonation in their verbal interactions with their mothers, demonstrating a similar pattern in the current study. Greater emotional intonation in verbal interactions was also demonstrated among children with ADHD when interacting with peers and this was particularly true for children with high levels of comorbid aggression (Hinshaw & Melnick, 1995). These findings suggest that emotional impulsivity and deficits in emotional self-regulation may be especially apparent for children with ADHD and clinically significant behavioral problems (Barkley 2015a).

Some specific behavioral parent changes have been made for families of children with ADHD to address their unique needs. If parents of children with ADHD are getting pulled into their child's emotional arousal, that may indicate that more time should be spent in treatment practicing proactive planning and redirection and intentional ignoring of off-task behavior. In a clean-up task where a child is asked to put away novel toys, it is likely that many became distracted and wanted to play. In these instances, parents would be most effective by staying consistent and firm with directions paired with effusive praise following compliance. A recent meta-analysis of BPT components on treatment outcomes for children with ADHD in particular found that dosage of teaching parents to manipulate antecedents and anticipate problem behavior was positively associated with treatment effects of parenting sense of competence and parental mental health (Dekkers et al., 2022). Noted disorganization and executive function deficits among children with ADHD make stimulus control strategies especially important for this group (Martinussen, Hayden, Hogg-Johnson, & Tannock, 2005; van der Oord & Trip, 2020; Willcutt, et al., 2005). Greater structure, rules, and task organization skills have also been associated with improved *parent* mental health as well (Dekkers et al., 2022), which may be due to the high incidence of ADHD symptoms and executive dysfunction found among a large proportion of parents of children with ADHD (e.g., Faraone, et al., 2005).

The high incidence of parent stress associated with childhood ADHD may also underline the importance of child dysregulation and expressed emotional arousal, given that parents were most affected by children with ADHD, who also had more arousal in the observation. Although it is known by clinicians and researchers that children with ADHD display immature self-regulatory processes, this is not widely known by parents (see Dahl et al., 2020 and Montoya, Colom, & Ferrin, 2011 for reviews on importance of parent psychoeducation for ADHD). Parent negative appraisal bias in response to child behavior has been linked to increased harsh/overreactive parenting (Lorber 2012) but was also found to be associated with parent's emotional flooding during their toddler's tantrums (Mence et al., 2014). As such, parent's reactivity to children with ADHD, likely displaying emotional arousal beyond what would be developmentally expected, may have elicited more emotional reactivity from their parents in part due to expectations of better regulation at their age. Cole, Ledonne, and Tan (2013) found that child disruptive behavior elicited maternal negative emotion during a parent-child observation task only at 48-months, not when children were 18, 24, or 36 months. The authors suggest that the emotionally evocative nature of certain parenting challenges changes over the course of development, particularly with regard to child disruptive behaviors which are socially apparent and potentially more embarrassing for parents as children grow older.

Strengths and Limitations

The findings and interpretations discussed should be taken in the context of both strengths and limitations of the current study. This study provided a unique affective perspective on parent-child interactions in early childhood based on vocally expressed emotional arousal. Using fundamental frequency measured every .25 seconds, this method provided more granular patterns than manually coded alternatives which typically offer repeated time-series observations of several seconds to minutes at a time. Moreover, this process minimizes the subjectivity inherent in even highly rigorous coding systems. An additional strength of capturing physiological emotional arousal through voice, versus RSA or other psychophysiological method, is that variations are communicated directly to the other person which allows for more in-depth analysis of affective interpersonal responses. Vocal tone is important in all interpersonal communication but may be especially sensitive between parents and their children. It is implicated in conceptualizations of the coercive model contributing to increased conflict and emotional arousal between parents and young children over time. In relation to overreactive or harsh parenting, it is seen as potentially a measure-able precursor to parental aggressive behavior, which is why parental harsh vocal tone and yelling has been examined in risk models for child maltreatment (Joosen et al., 2013). In addition, the use of interdependence statistical analyses that allow investigators to examine the effect of one's own affect on their emotional trajectory, as well as the impact of their partner, provides some insight into intraindividual regulatory processes in the context of an interpersonal interactions. Providing more windows into understanding affective determinants of parenting based on theory stipulating that parent's own experiences of emotion in response to their children's emotions are the most proximal predictors of their active emotion-socialization behaviors or their behavioral responses to children's emotions (Dix 1991). These results contribute dynamic interpersonal patterns for early-onset BDs and demonstrated some differences in parental emotional response that may be specific to children with ADHD *and* problem behavior.

The current study has a number of limitations that are important to consider in interpreting findings and building toward future research. First, as noted throughout, this sample included treatment-seeking parents of children in the 3-8 year old range with clinically significant problem behavior. It is unclear whether the affective patterns described are limited to children with BDs (with the caveat that there were some differences observed with comorbid ADHD within sample) or if these patterns would have been seen in a typically-developing, community sample. Additionally, the majority of parents included were female, with only 10% fathers. Unfortunately, this is not unique to the current study as it is much more common for mothers to present as the primary caregiver and it is necessary for the demands of treatment that the primary caregiver participate in treatment. In the parent literature broadly, the study of parenting mechanisms for fathers is nascent but developing (Adamsons & Buehler, 2007; Loiselle et al., 2021; Parent et al., 2017). Prior research does not indicate that there should be a difference in these processes for fathers versus mothers, on the contrary most studies applying parenting theory to fathers have found that the same behaviors and styles apply similarly to fathers of children in this age-range, but future research is needed to confirm and expand this area of our understanding.

Future Directions of f_0 in Parent-Child Interactions Research

The current study represents a secondary analysis of data from a feasibility pilot study that is the first to use f_0 methods with parent-child dyads in this age range, inspired by the utility of this approach in couples research (e.g., Fischer et al., 2017; 2022; Weber et al., 2019). Several important differences emerged in the application with young children and parents in comparison to data collected from couples that should be carefully considered in future research. First, parents and children in this age range communicate more behaviorally than two adults due to the verbal and developmental level of the children included. This is particularly the case for a task that involves some communication and response based on behavior, such as a child complying and cleaning up while whining versus behavioral noncompliance. The content of the discussion (in contrast to emotional arousal conveyed with vocal tone) would elicit reactions among couples and parent-child dyads alike, but this may be particularly important when a dyad is collaborating to solve a task rather than an emotional conversation. In addition, parent-child dyads in this age range tend to be more emotionally animated during interactions, using more exaggerated gestures, facial expressions, and vocal tone to match child's level of engagement, attention, and regulation abilities at their stage of development. While f_0 surely captures the range in vocalizations, there may be more emotional information to glean from facial expressions than would be important in couples' conversation.

A comparable method that is widely used for analyzing emotion coregulation in parent-child dyads from toddlerhood to adolescence is using affective coding systems based on collapsed ratings of facial expressions, vocal tone, speech, and socially oriented behavior. For coregulation research, these data are often analyzed using State Space Grids (Bardack et al., 2017; Granic & Hollenstein, 2003; Hollenstein, 2011) based on "attractor states" in which the dyad is attracted to mutually determined emotional states (Lunkenheimer & Dishion, 2009). Similar to the analyses reported in the current study, these methods are focused on some view of coordinated affect. Attractor theory posits that parent positive emotion increases the likelihood that child emotion become more positive and vice versa, simultaneously pulling away from coupled negative affect states. Attractors are thought to be unique to each parent-child dyad which over-time become stable and shape the dyad's future emotional interactions (Fogel, 1993). Stable dyadic negativity increases the likelihood of future dyadic negativity (Hollenstein, et al., 2004) whereas positive interactions lead to future positive interactions (Lunkenheimer et al., 2011). In early childhood, positive dyadic synchrony has been associated with better effortful control (Kochanska et al., 2008) and fewer behavior problems (Lunkenheimer, Ram, et al., 2017). However, covariation and coupling of f_0 both focus on a certain aspect of *change* in one individual's arousal or regulation trajectory based off of the arousal of the other person. This does not directly, conceptually correspond to the literature on synchrony as a proxy for coregulation or the use of traditional affective coding systems and State Space Grids. Importantly, f_0 emotion dynamics are conceptualized through a homeostatic process of emotion regulation - which the above methods do not have continuous and reliable affective data available to model – and is more akin to psychophysiological process methods in this way but adds the benefit of the data being socially transmittable versus autonomic regulatory processes that are not externally apparent.

Building from the results of this study, future research using f_0 should compare results with other affective coding measures to connect these literatures and provide a synthesized framework for using this novel methodology with parent-child dyads in early childhood. Using recording of interactions to analyze emotional dynamics could offer the opportunity to study interactions outside of the lab in the context of the home environment. Though the limitations of laboratory-based, structured, interactions have been acknowledged regularly in the study of parent-child relationships, it has been challenging to develop feasible research methods to study more realistic interactions. The environmental circumstances of parent-child interactions may be especially important for examining parental emotion, stress, and self-regulation since parents may be more or less stressed about completing a task in a controlled and structured – but clinical and recorded – environment. Concerns about social acceptability when reporting about their parenting or engaging with their child during a research study are possibly the most significant in parenting research than other areas of clinical psychology because of high expectations and judgements placed on parents, especially mothers. Even if parents know they are being recorded and are aware of their participation in a research study, engaging with their child in their own home, embedded in their typical routine, may provide useful information about important emotional processes at the heart of parent-child conflict. Better understanding these mechanisms could in turn inform more effective distress tolerance and emotion regulation skills for parents to bolster behavioral parent training protocols and support parents with poorer self-regulatory skills to succeed in treatment.

In conclusion, parental self-regulation is a crucial piece of the puzzle comprising the determinants of parenting style and behavior. Along with the determining and maintaining factors, the consequences of maladaptive parenting require consideration as antecedents and consequences of behavior cycle back and forth in the timeline of a parent-child relationship, perpetually informing the next interaction. The quality of the parent-child relationship is one of the most basic and important factors in child development, as it serves the foundation for future significant peer and marital relationships and adaptive socioemotional development, as well as a protective factor against various forms of psychopathology. On the other side of the dyad, parents who are feeling ineffective and struggling in their relationship with their child are also vulnerable to a host of mental health concerns. Parents of children with significant BDs often have to face challenges with maintaining childcare, expulsions from school, and even their own job security when they are frequently needing to miss work to care for their child. They cope with judgement and conflict from neighbors, fellow patrons at a supermarket, and anyone else in earshot of their child's frequent, lengthy, and *loud* tantrums. Engaging with defiant and poorly regulated children is exhausting, but these social consequences of disruptive behavior can cost parents the opportunities to take needed breaks from their child and maintain other areas of their personal and professional lives. This narrative characterizes a vicious cycle of stress, embarrassment, and isolation that is increasingly challenging to break out of. How parents respond affectively to the repeated stress at the second-to-second level in an aversive interaction would inform their tendencies to cope in future interactions and help to understand which parents may be inclined to give in or alternatively lash out in the heat of the moment. Extending research to characterize the complex ways parents react, regulate, and respond to their children when under stress will enrich theory and inform emotionally-informed clinical applications to serve parents.

APPENDIX A: DIFFICULTIES IN EMOTION REGULATION SCALE

Family ID:_____

APPROVED - IRB, UNC-CH
MAY 20 2010

DERS

INSTRUCTIONS: Please indicate how often the following statements apply to you by writing the appropriate number from the scale below on the line beside each item.

1	2	3	4	5
almost never (0-10%)	sometimes (11-35%)	about half the time (36-65%)	most of the time (66-90%)	almost always (91-100%)

_____ 1) I am clear about my feelings.

_____ 2) I pay attention to how I feel.

_____ 3) I experience my emotions as overwhelming and out of control.

_____ 4) I have no idea how I am feeling.

_____ 5) I have difficulty making sense out of my feelings.

_____ 6) I am attentive to my feelings.

_____ 7) I know exactly how I am feeling.

_____ 8) I care about what I am feeling.

_____ 9) I am confused about how I feel.

_____ 10) When I'm upset, I acknowledge my emotions.

_____ 11) When I'm upset, I become angry with myself for feeling that way.

_____ 12) When I'm upset, I become embarrassed for feeling that way.

_____ 13) When I'm upset, I have difficulty getting work done.

_____ 14) When I'm upset, I become out of control.

_____ 15) When I'm upset, I believe that I will remain that way for a long time.

_____ 16) When I'm upset, I believe that I'll end up feeling very depressed.

_____ 17) When I'm upset, I believe that my feelings are valid and important.

_____ 18) When I'm upset, I have difficulty focusing on other things.

_____ 19) When I'm upset, I feel out of control.

_____ 20) When I'm upset, I can still get things done.

_____ 21) When I'm upset, I feel ashamed with myself for feeling that way.

1	2	3	4	5
almost never (0-10%)	sometimes (11-35%)	about half the time (36-65%)	most of the time (66-90%)	almost always (91-100%)

______ 22) When I'm upset, I know that I can find a way to eventually feel better.

______ 23) When I'm upset, I feel like I am weak.

______ 24) When I'm upset, I feel like I can remain in control of my behaviors.

______ 25) When I'm upset, I feel guilty for feeling that way.

______ 26) When I'm upset, I have difficulty concentrating.

______ 27) When I'm upset, I have difficulty controlling my behaviors.

______ 28) When I'm upset, I believe that there is nothing I can do to make myself feel better.

______ 29) When I'm upset, I become irritated with myself for feeling that way.

______ 30) When I'm upset, I start to feel very bad about myself.

______ 31) When I'm upset, I believe that wallowing in it is all I can do.

______ 32) When I'm upset, I lose control over my behaviors.

______ 33) When I'm upset, I have difficulty thinking about anything else.

______ 34) When I'm upset, I take time to figure out what I'm really feeling.

______ 35) When I'm upset, it takes me a long time to feel better.

______ 36) When I'm upset, my emotions feel overwhelming.

APPENDIX B: BEHAVIOR RATING INVENTORY OF EXECUTIVE FUNCTION-ADULT VERSION

Your Name____ Today's Date____/____/____

Gender ☐ Male ☐ Female Age________ Date of Birth____/____/____

Years of Education:_______ Level of Education: ☐ Less than High School ☐ High School ☐ College ☐ Master's degree ☐ Doctorate ☐ Other

During the past month, how often has each of the following behaviors been a *problem*?

N = Never S = Sometimes O = Often

1.	I have angry outbursts	N	S	O
2.	I make careless errors when completing tasks	N	S	O
3.	I am disorganized	N	S	O
4.	I have trouble concentrating on tasks (such as chores, reading, or work)	N	S	O
5.	I tap my fingers or bounce my legs	N	S	O
6.	I need to be reminded to begin a task even when I am willing	N	S	O
7.	I have a messy closet	N	S	O
8.	I have trouble changing from one activity or task to another	N	S	O
9.	I get overwhelmed by large tasks	N	S	O
10.	I forget my name	N	S	O
11.	I have trouble with jobs or tasks that have more than one step	N	S	O
12.	I overreact emotionally	N	S	O
13.	I don't notice when I cause others to feel bad or get mad until it is too late	N	S	O
14.	I have trouble getting ready for the day	N	S	O
15.	I have trouble prioritizing activities	N	S	O
16.	I have trouble sitting still	N	S	O
17.	I forget what I am doing in the middle of things	N	S	O
18.	I don't check my work for mistakes	N	S	O
19.	I have emotional outbursts for little reason	N	S	O
20.	I lie around the house a lot	N	S	O
21.	I start tasks (such as cooking, projects) without the right materials	N	S	O
22.	I have trouble accepting different ways to solve problems with work, friends, or tasks	N	S	O
23.	I talk at the wrong time	N	S	O
24.	I misjudge how difficult or easy tasks will be	N	S	O
25.	I have problems getting started on my own	N	S	O
26.	I have trouble staying on the same topic when talking	N	S	O
27.	I get tired	N	S	O
28.	I react more emotionally to situations than my friends	N	S	O
29.	I have problems waiting my turn	N	S	O
30.	People say that I am disorganized	N	S	O
31.	I lose things (such as keys, money, wallet, homework, etc.)	N	S	O
32.	I have trouble thinking of a different way to solve a problem when stuck	N	S	O
33.	I overreact to small problems	N	S	O
34.	I don't plan ahead for future activities	N	S	O
35.	I have a short attention span	N	S	O
36.	I make inappropriate sexual comments	N	S	O
37.	When people seem upset with me, I don't understand why	N	S	O
38.	I have trouble counting to three	N	S	O

During the past month, how often has each of the following behaviors been a *problem*?

N = Never   S = Sometimes   O = Often

39.	I have unrealistic goals	N	S	O
40.	I leave the bathroom a mess	N	S	O
41.	I make careless mistakes	N	S	O
42.	I get emotionally upset easily	N	S	O
43.	I make decisions that get me into trouble (legally, financially, socially)	N	S	O
44.	I am bothered by having to deal with changes	N	S	O
45.	I have difficulty getting excited about things	N	S	O
46.	I forget instructions easily	N	S	O
47.	I have good ideas but cannot get them on paper	N	S	O
48.	I make mistakes	N	S	O
49.	I have trouble getting started on tasks	N	S	O
50.	I say things without thinking	N	S	O
51.	My anger is intense but ends quickly	N	S	O
52.	I have trouble finishing tasks (such as chores, work)	N	S	O
53.	I start things at the last minute (such as assignments, chores, tasks)	N	S	O
54.	I have difficulty finishing a task on my own	N	S	O
55.	People say that I am easily distracted	N	S	O
56.	I have trouble remembering things, even for a few minutes (such as directions, phone numbers)	N	S	O
57.	People say that I am too emotional	N	S	O
58.	I rush through things	N	S	O
59.	I get annoyed	N	S	O
60.	I leave my room or home a mess	N	S	O
61.	I get disturbed by unexpected changes in my daily routine	N	S	O
62.	I have trouble coming up with ideas for what to do with my free time	N	S	O
63.	I don't plan ahead for tasks	N	S	O
64.	People say that I don't think before acting	N	S	O
65.	I have trouble finding things in my room, closet, or desk	N	S	O
66.	I have problems organizing activities	N	S	O
67.	After having a problem, I don't get over it easily	N	S	O
68.	I have trouble doing more than one thing at a time	N	S	O
69.	My mood changes frequently	N	S	O
70.	I don't think about consequences before doing something	N	S	O
71.	I have trouble organizing work	N	S	O
72.	I get upset quickly or easily over little things	N	S	O
73.	I am impulsive	N	S	O
74.	I don't pick up after myself	N	S	O
75.	I have problems completing my work	N	S	O

APPENDIX C: COPING WITH CHILDREN'S NEGATIVE EMOTIONS SCALE

APPROVED ... IRB, UNC-CH Family ID:_____

MAY 20 2010

Parent Attitude / Behavior Questionnaire

Instructions: In the following items, please indicate on a scale from 1 (very unlikely) to 7 (very likely) the likelihood that you would respond in the ways listed for each item. Please read each item carefully and respond as honestly and sincerely as you can. For each response, please circle a number from 1-7.

Response Scale:	1	2	3	4	5	6	7
	Very Unlikely			Medium			Very Likely

1. If my child becomes angry because he/she is sick or hurt and can't go to his/her friend's birthday party, I would:

a. send my child to his/her room to cool off	1 2 3 4 5 6 7
b. get angry at my child	1 2 3 4 5 6 7
c. help my child think about ways that he/she can still be with friends (e.g., invite some friends over after the party)	1 2 3 4 5 6 7
d. tell my child not to make a big deal out of missing the party	1 2 3 4 5 6 7
e. encourage my child to express his/her feelings of anger and frustration	1 2 3 4 5 6 7
f. soothe my child and do something fun with him/her to make him/her feel better about missing the party	1 2 3 4 5 6 7

2. If my child falls off his/her bike and breaks it, and then gets upset and cries, I would:

a. remain calm and not let myself get anxious	1 2 3 4 5 6 7
b. comfort my child and try to get him/her to forget about the accident	1 2 3 4 5 6 7
c. tell my child that he/she is over-reacting	1 2 3 4 5 6 7
d. help my child figure out how to get the bike fixed	1 2 3 4 5 6 7
e. tell my child it's OK to cry	1 2 3 4 5 6 7
f. tell my child to stop crying or he/she won't be allowed to ride his/her bike anytime soon	1 2 3 4 5 6 7

3. If my child loses some prized possession and reacts with tears, I would:

a. get upset with him/her for being so careless and then crying about it	1 2 3 4 5 6 7
b. tell me child that he/she is over-reacting	1 2 3 4 5 6 7
c. help my child think of places he/she hasn't looked yet	1 2 3 4 5 6 7
d. distract my child by talking about happy things	1 2 3 4 5 6 7
e. tell my child it's OK to cry when you feel unhappy	1 2 3 4 5 6 7
f. tell him/her that's what happens when you're not careful	1 2 3 4 5 6 7

4. If my child is afraid of injections and becomes quite shaky and teary while waiting for his/her turn to get a shot, I would:

a. tell him/her to shape up of he/she won't be allowed to do something he/she likes to do (e.g., watch TV)	1 2 3 4 5 6 7
b. encourage my child to talk about his/her fears	1 2 3 4 5 6 7

c. tell my child not to make a big deal of the shot 1 2 3 4 5 6 7
d. tell him/her not to embarrass us by crying 1 2 3 4 5 6 7
e. comfort him/her before and after the shot 1 2 3 4 5 6 7
f. talk to my child about ways to make it hurt less (such as relaxing so it won't hurt or taking deep breaths) 1 2 3 4 5 6 7

5. If my child is going to spend the afternoon at a friend's house and becomes nervous and upset because I can't stay there with him/her, I would:

a. distract my child my talking about all the fun he/she will have with his/her friend 1 2 3 4 5 6 7
b. help my child think of things that he/she could do so that being at the friend's house without me wasn't scary (e.g., take a favorite book or toy with him/her) 1 2 3 4 5 6 7
c. tell my child to quit over-reacting and being a baby 1 2 3 4 5 6 7
d. tell my child that is he/she doesn't stop that he/she won't be allowed to go out anymore 1 2 3 4 5 6 7
e. feel upset and uncomfortable because of my child's reaction 1 2 3 4 5 6 7
f. encourage my child to talk about his/her nervous feelings 1 2 3 4 5 6 7

6. If my child is participating in some group activity with his/her friends and proceeds to make a mistake and then looks embarrassed and on the verge of tears, I would:

a. comfort my child and try to make him/her feel better 1 2 3 4 5 6 7
b. tell my child that he/she is over-reacting 1 2 3 4 5 6 7
c. feel uncomfortable and embarrassed myself 1 2 3 4 5 6 7
d. tell my child to straighten up or we'll go home right away 1 2 3 4 5 6 7
e. encourage my child to talk about his/her feelings of embarrassment 1 2 3 4 5 6 7
f. tell my child that I'll help him/her practice so that he/she can do better next time 1 2 3 4 5 6 7

7. If my child is about to appear in a recital or sports activity and becomes visibly nervous about people watching him/her, I would:

a. help my child think of things that he/she could do to get ready for his/her turn (e.g., to do some warm-ups and not to look at the audience) 1 2 3 4 5 6 7
b. suggest that my child think about something relaxing 1 2 3 4 5 6 7
c. remain calm and not get nervous myself 1 2 3 4 5 6 7
d. tell my child that he/she is being a baby about it 1 2 3 4 5 6 7
e. tell my child that if he/she doesn't calm down, we'll have to leave and go home right away 1 2 3 4 5 6 7
f. encourage my child to talk about his/her nervous feelings 1 2 3 4 5 6 7

8. If my child receives an undesirable birthday gift from a friend and looks obviously disappointed, even annoyed, after opening it in the presence of a friend, I would:

a. encourage my child to express his/her disappointed feelings 1 2 3 4 5 6 7
b. tell my child that the present can be exchanged for something the child wants 1 2 3 4 5 6 7
c. NOT be annoyed with my child for being rude 1 2 3 4 5 6 7
d. tell my child that he/she is over-reacting 1 2 3 4 5 6 7
e. scold my child for being insensitive to the friend's feelings 1 2 3 4 5 6 7
f. try to get my child to feel better by doing something fun 1 2 3 4 5 6 7

9. If my child is panicky and can't go to sleep after watching a scary TV show, I would:

a. encourage my child to talk about what scared him/her 1 2 3 4 5 6 7
b. get upset with him/her for being silly 1 2 3 4 5 6 7
c. tell my child he/she is over-reacting 1 2 3 4 5 6 7
d. help my child think of something to do so that he/she can get to sleep (e.g., take a toy to bed, leave the lights on) 1 2 3 4 5 6 7
e. tell him/her to go to bed or he/she won't be allowed to watch any more TV 1 2 3 4 5 6 7
f. do something fun with my child to help him/her forget about what scared him/her 1 2 3 4 5 6 7

10. If my child is at a park and appears on the verge of tears because the other children are mean to him/her and won't let him/her play with them, I would:

a. NOT get upset myself 1 2 3 4 5 6 7
b. tell my child that if he/she starts crying then we'll have to go home right away 1 2 3 4 5 6 7
c. tell my child it's OK to cry when he/she feels bad 1 2 3 4 5 6 7
d. comfort my child and try to get him/her to think about something happy 1 2 3 4 5 6 7
e. help my child think of something else to do 1 2 3 4 5 6 7
f. tell my child that he/she will feel better soon 1 2 3 4 5 6 7

11. If my child is playing with other children and one of them calls him/her names, and my child then begins to tremble and become tearful, I would:

a. tell my child not to make a big deal of it 1 2 3 4 5 6 7
b. feel upset myself 1 2 3 4 5 6 7
c. tell my child to behave or we'll have to go home right away 1 2 3 4 5 6 7
d. help my child think of constructive things to do when other children tease him/her (e.g., find other things to do) 1 2 3 4 5 6 7
e. comfort him/her and play a game to take his/her mind off the upsetting event 1 2 3 4 5 6 7
f. encourage him/her to talk about how it hurts to be teased 1 2 3 4 5 6 7

Family ID:_____

12. If my child is shy and scared around strangers and consistently becomes teary and wants to stay in his/her bedroom whenever family friends come to visit, I would:

a. help my child think of things to do that would make meeting my friends less scary (e.g., take a favorite toy with him/her when meeting my friends)	1 2 3 4 5 6 7
b. tell my child that it is OK to feel nervous	1 2 3 4 5 6 7
c. try to make my child happy by talking about the fun things we can do with our friends	1 2 3 4 5 6 7
d. feel upset and uncomfortable because of my child's reactions	1 2 3 4 5 6 7
e. tell my child that he/she must stay in the living room and visit with our friends	1 2 3 4 5 6 7
f. tell my child that he/she is being a baby	1 2 3 4 5 6 7

APPENDIX D: O'LEARY PARENTING SCALE

PARENTING SCALE

At one time or another, all children misbehave or do things that could be harmful, that are "wrong", or that parents don't like. Examples include: hitting someone, whining, throwing food, forgetting homework, not picking up toys, lying, having a tantrum, refusing to go to bed, wanting a cookie before dinner, running into the street, arguing back, coming home late.

Parents have many different ways or styles of dealing with these types of problems. Below are items that describe some styles of parenting. For each item, circle the number that best describes your style of parenting during the past 2 months with your child.

Sample Item

At meal time...

I let my child decide how much to eat.	1	(2)	3	4	5	6	7	I decide how much my child eats.

1. When my child misbehaves...

I do something right away.	1	2	3	4	5	6	7	I do something about it later.

2. Before I do something about a problem...

I give my child several reminders or warnings.	1	2	3	4	5	6	7	I use only one reminder or warning.

3. When I'm upset or under stress...

I am picky and on my child's back.	1	2	3	4	5	6	7	I am no more picky than usual.

4. When I tell my child not to do something...

I say very little.	1	2	3	4	5	6	7	I say a lot.

5. When my child pesters me...

I can ignore the pestering.	1	2	3	4	5	6	7	I can't ignore the pestering.

6. When my child misbehaves...

I usually get into a long argument with my child.	1	2	3	4	5	6	7	I don't get into an argument.

7. I threaten to do things that...

I am sure I can carry out.	1	2	3	4	5	6	7	I know I won't actually do.

8. I am the kind of parent that...

sets limits on what my child is allowed to do.	1	2	3	4	5	6	7	lets my child do whatever he or she wants.

9. When my child misbehaves...

I give my child a long lecture.	1	2	3	4	5	6	7	I keep my talks short and to the point.

10. When my child misbehaves...

I raise my voice or yell.	1	2	3	4	5	6	7	I speak to my child calmly.

11. If saying no doesn't work right away...

I take some other kind of action.	1	2	3	4	5	6	7	I keep talking and trying to get through to my child.

12. When I want my child to stop doing something...

I firmly tell my child to stop.	1	2	3	4	5	6	7	I coax or beg my child to stop.

13. When my child is out of my sight...

I often don't know what my child is doing.	1	2	3	4	5	6	7	I always have a good idea of what my child is doing.

14. After there's been a problem with my child...

I often hold a grudge.	1	2	3	4	5	6	7	things get back to normal quickly.

15. When we're not at home...

I handle my child the way I do at home.	1	2	3	4	5	6	7	I let my child get away with a lot more.

16. When my child does something I don't like...

I do something about it every time it happens.	1	2	3	4	5	6	7	I often let it go.

17. When there's a problem with my child...

things build up and I do things I don't mean to do.	1	2	3	4	5	6	7	things don't get out of hand.

18. When my child misbehaves, I spank, slap, grab, or hit my child...

never or rarely.	1	2	3	4	5	6	7	most of the time.

19. When my child doesn't do what I ask...

I often let it go or end up doing it myself.	1	2	3	4	5	6	7	I take some other action.

20. When I give a fair threat or warning...

I often don't carry it out.	1	2	3	4	5	6	7	I always do what I said.

21. If saying "No" doesn't work...

I take some other kind of action.	1	2	3	4	5	6	7	I offer my child something nice so he/she will behave.

22. When my child misbehaves...

I handle it without getting upset.	1	2	3	4	5	6	7	I get so frustrated or angry that my child can see I'm upset.

23. When my child misbehaves...

I make my child tell me why he/she did it.	1	2	3	4	5	6	7	I say "No" or take some other action.

24. If my child misbehaves and then acts sorry...

I handle the problem like I usually would.	1	2	3	4	5	6	7	I let it go that time.

25. When my child misbehaves...

I rarely use bad language or curse.	1	2	3	4	5	6	7	I almost always use bad language.

26. When I say my child can't do something...

I let my child do it anyway.	1	2	3	4	5	6	7	I stick to what I said.

27. When I have to handle a problem...

I tell my child I am sorry about it.	1	2	3	4	5	6	7	I don't say I'm sorry.

28. When my child does something I don't like, I insult my child, say mean things, or call my child names...

never or rarely.	1	2	3	4	5	6	7	most of the time.

29. If my child talks back or complains when I handle a problem...

I ignore the complaining and stick to what I said.	1	2	3	4	5	6	7	I give my child a talk about not complaining.

30. If my child gets upset when I say "No"...

I back down and give in to my child.	1	2	3	4	5	6	7	I stick to what I said.

APPENDIX E: EYBERG CHILD BEHAVIOR INVENTORY

ECBI™ Eyberg Child Behavior Inventory™

Parent Rating Form by Sheila Eyberg, PhD

Your Name ____________ Relationship to Child ________ Today's Date __/__/__

Child's Name ____________ Child's Gender ________ Child's Date of Birth __/__/__

Directions: Below are a series of phrases that describe children's behavior. Please (1) circle the number describing **how often** the behavior **currently** occurs with your child, and (2) circle either "yes" **or** "no" to indicate whether the behavior is **currently a problem for you**.

For example, if seldom, you would circle the 2 in response to the following statement:

	Never	Seldom		Sometimes	Often		Always	Is this a problem for you?	
1. Refuses to eat vegetables	1	(2)	3	4	5	6	7	YES	(NO)

Circle only one response for each statement, and respond to all statements. **DO NOT ERASE!** If you need to change an answer, make an "X" through the incorrect answer and circle the correct response. For example:

1. Refuses to eat vegetables	1	(2)	(X)	4	5	6	7	YES	(NO)

	How often does this occur with your child?							Is this a problem for you?	
	Never	Seldom		Sometimes	Often		Always		
1. Dawdles in getting dressed	1	2	3	4	5	6	7	YES	NO
2. Dawdles or lingers at mealtime	1	2	3	4	5	6	7	YES	NO
3. Has poor table manners	1	2	3	4	5	6	7	YES	NO
4. Refuses to eat food presented	1	2	3	4	5	6	7	YES	NO
5. Refuses to do chores when asked	1	2	3	4	5	6	7	YES	NO
6. Slow in getting ready for bed	1	2	3	4	5	6	7	YES	NO
7. Refuses to go to bed on time	1	2	3	4	5	6	7	YES	NO
8. Does not obey house rules on own	1	2	3	4	5	6	7	YES	NO
9. Refuses to obey until threatened with punishment	1	2	3	4	5	6	7	YES	NO
10. Acts defiant when told to do something	1	2	3	4	5	6	7	YES	NO
11. Argues with parents about rules	1	2	3	4	5	6	7	YES	NO
12. Gets angry when doesn't get own way	1	2	3	4	5	6	7	YES	NO
13. Has temper tantrums	1	2	3	4	5	6	7	YES	NO
14. Sasses adults	1	2	3	4	5	6	7	YES	NO
15. Whines	1	2	3	4	5	6	7	YES	NO
						Page 1 subtotals			

OVER →

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	How often does this occur with your child?							Is this a problem for you?	
	Never	Seldom		Sometimes		Often	Always		
16. Cries easily	1	2	3	4	5	6	7	YES	NO
17. Yells or screams	1	2	3	4	5	6	7	YES	NO
18. Hits parents	1	2	3	4	5	6	7	YES	NO
19. Destroys toys and other objects	1	2	3	4	5	6	7	YES	NO
20. Is careless with toys and other objects	1	2	3	4	5	6	7	YES	NO
21. Steals	1	2	3	4	5	6	7	YES	NO
22. Lies	1	2	3	4	5	6	7	YES	NO
23. Teases or provokes other children	1	2	3	4	5	6	7	YES	NO
24. Verbally fights with friends own age	1	2	3	4	5	6	7	YES	NO
25. Verbally fights with sisters and brothers	1	2	3	4	5	6	7	YES	NO
26. Physically fights with friends own age	1	2	3	4	5	6	7	YES	NO
27. Physically fights with sisters and brothers	1	2	3	4	5	6	7	YES	NO
28. Constantly seeks attention	1	2	3	4	5	6	7	YES	NO
29. Interrupts	1	2	3	4	5	6	7	YES	NO
30. Is easily distracted	1	2	3	4	5	6	7	YES	NO
31. Has short attention span	1	2	3	4	5	6	7	YES	NO
32. Fails to finish tasks or projects	1	2	3	4	5	6	7	YES	NO
33. Has difficulty entertaining self alone	1	2	3	4	5	6	7	YES	NO
34. Has difficulty concentrating on one thing	1	2	3	4	5	6	7	YES	NO
35. Is overactive or restless	1	2	3	4	5	6	7	YES	NO
36. Wets the bed	1	2	3	4	5	6	7	YES	NO

Page 2 subtotals		
Subtotals from page 1		

Scores	Raw score	*T* score	Exceeds Cutoff (✓)
Intensity			
Problem			

Comments:

APPENDIX F: TABLES 1-7

Table 1

Sample Demographic Characteristics and Study Variable Means

Variables	Total N = 50 Mean (SD); Count (%)
Child Characteristics	
Mean Age (years) (SD)	4.81(1.14)
Child sex (girl)	27 (54%)
Child Race	
White	39 (78%)
African American	2 (4%)
Asian or Pacific Islander	2 (4%)
More than one race	7 (14%)
Hispanic/Latino ethnicity	4 (8%)
MINI Kid ADHD	17 (34%)
Mean ECBI Intensity (SD)	149.18 (23.23)
Mean ECBI Problem (SD)	22.45 (6.30)
Parent Characteristics	
Mean Parent Age (years) (SD)	38.6 (5.20)
Parent sex (Female)	45 (90%)
Parent Race	
White	45 (90%)
African American	2 (4%)
Asian or Pacific Islander	3 (6%)
More than one race	0 (0%)
Hispanic/Latino ethnicity	3 (6%)
Mean Estimated Gross Annual Income (SD)	$131,727 (72,030)
Mean OPS Total (SD)	98.25 (15.30)
Mean CCNES Reactivity (SD)	84.27 (18.91)
Mean DERS Total Score (SD)	69.98 (19.47)
Mean BRIEF GEC (SD)	97.59 (21.90)

Table 2

Bivariate Pearson Correlations

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Child Age																
2	Child Gender (Girl)	-0.21															
3	Child Racial/Ethnic Minority	-0.15	-0.01														
4	Parent Age	0.50**	-0.26	0.06													
5	Parent Gender (Female)	0.10	0.10	-0.22	-0.09												
6	Parent Racial/Ethnic Minority	0.06	0.07	0.67**	-0.13	-0.22											
7	Language Other Than English at Home	0.10	0.23	0.37**	-0.06	0.08	0.58**										
8	Household Income	-0.10	0.13	0.21	0.04	-0.04	-0.04	-0.04									
9	Parent Education Level	-0.17	0.15	0.30**	0.13	-0.08	0.18	-0.02	0.23								
10	Nonmarried Parent	-0.03	0.06	0.02	-0.03	0.08	0.12	-0.06	-0.11	-0.31*							
11	Child ADHD	0.07	0.15	0.18	0.01	-0.04	0.15	-0.00	-0.18	-0.14	0.35*						
12	ECBI Intensity	0.10	-0.02	-0.02	0.07	-0.14	-0.14	-0.06	-0.06	-0.07	0.11	0.38**					
13	ECBI Problem	0.17	0.12	0.12	0.11	0.07	0.07	0.03	-0.13	-0.13	0.22	0.28*	0.67**				
14	DERS Total	-0.08	0.29*	0.24^{+}	0.21	0.13	0.21	0.17	0.10	0.11	0.16	0.23	0.01	-0.02			
15	BRIEF GEC	-0.25	0.16	0.16	0.05	0.13	0.10	0.21	-0.17	-0.07	0.14	0.34**	0.19	0.18	0.50**		
16	CCNES Unsup/React	-0.01	0.03	0.03	0.02	0.13	0.19	0.28^{+}	0.03	-0.02	0.01	0.17	0.02	0.12	0.34*	0.25^{+}	
17	OPS Total	0.02	0.16	-0.03	0.14	0.02	0.13	0.09	0.13	0.13	-0.05	0.06	0.05	-0.01	0.34*	0.18	0.54**

$^{+}p < .10$, $*p<.05$, $**p<.01$

Table 3

Multiple Regression Analyses

Step and Variable	df	F	R^2	ΔR^2	B	SE	ß	pr
OPS Total (Laxness and Overreactivity)								
Step 1:	1,48	6.266*	.115	.115				
DERS Total					.286*	.110	.363	.357
Step 2:	2,47	3.068	.115	.000				
ECBI Problems					-.080	.347	-.033	-.034
Step 3:	3,46	4.173	.131	.016				
DERS X ECBI Problems					-.019	.020	-.131	-.133
OPS Total (Laxness and Overreactivity)	df	F	R^2	ΔR^2	B	SE	ß	pr
Step 1:	1,48	1.531	.031	.031				
BRIEF GEC					.130	.104	.183	.180
Step 2:	2,47	.795	.033	.002				
ECBI Problems					-.090	.371	-.037	-.036
Step 3:	3,46	.531	.033	.000				
BRIEF GEC X ECBI INT					.003	.017	.028	.187
OPS Total (Lax and Overreact)	df	F	R^2	ΔR^2	B	SE	ß	pr
Step 1:	2,47	3.070	.116	.116				
BRIEF GEC					.017	.117	.024	.021
DERS TOTAL					.271*	.127	.343	.299
Step 2:	3.46	2.044	.118	.002				
BRIEF GEC X DERS Total					-.001	.004	-.049	-.048
CCNES Unsupportive/Reactive	df	F	R^2	ΔR^2	B	SE	ß	pr
Step 1:	1,48	2.373	.048	.048				
DERS Total					.167	.114	.208	.210
Step 2:	2,47	1.329	.055	.007				
ECBI Problems					.297	.358	.124	.123
Step 3:	3,46	1.244	.077	.022				
DERS X ECBI Problems					.022	.021	.155	.152
CCNES Unsupportive/Reactive	df	F	R^2	ΔR^2	B	SE	ß	pr
Step 1:	1,48	3.094	.061	.061				
BRIEF GEC					.198	.121	.229	.235
Step 2:	2,47	1.665	.066	.006				
ECBI Problems					.415	.429	.139	.141
Step 3:	3,46	2.373	.134	.068				
BRIEF GEC X ECBI INT					.038	.020	.268	.270
CCNES Unsupportive/Reactive	df	F	R^2	ΔR^2	B	SE	ß	pr
Step 1:	2,47	1.912	.077	.077				
BRIEF GEC					.140	.118	.204	.175
DERS TOTAL					.102	.134	.127	.113
Step 2:	3,46	1.260	.078	.001				
BRIEF GEC X DERS Total					-.001	.004	-0.030	-.029

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

Table 4

Change as Outcome Actor-Partner Interdependence Models: Clean Up Task

	Clean Up Task					
		Parent			Child	
Effect	*B*	*SE*	*p*	*B*	*SE*	*p*
Intercept	147.09**	7.463	<.0001	270.58**	13.810	<.0001
Actor Effects	-0.869**	0.029	<.0001	-0.915**	0.209	<.0001
Partner Effects	0.062**	0.015	<.0001	0.021	0.054	0.692
Actor Effects X DERS	0.001	0.002	0.547	-0.001	0.002	0.717
Partner Effects X DERS	0.001	0.001	0.209	0.000	0.003	0.972
Actor Effects X GEC	0.001	0.001	0.722	-0.001	0.001	0.332
Partner Effects X GEC	-0.001	0.001	0.427	0.001	0.003	0.757
Actor Effects X ADHD	-0.002	0.059	0.975	0.086	0.060	0.153
Partner Effects X ADHD	0.005	0.032	0.879	0.142	0.113	0.202

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

Table 5

Change as Outcome Actor-Partner Interdependence Models: Delayed Gratification Task

	Delayed Gratification Task					
	Parent			Child		
Effect	*B*	*SE*	*p*	*B*	*SE*	*p*
Intercept	134.45**	7.341	<.0001	229.49**	12.853	<.0001
Actor Effects	-0.825**	0.029	<.0001	-0.847**	0.029	<.0001
Partner Effects	0.061**	0.016	0.0002	0.103*	0.050	0.040
Actor Effects X DERS	-0.002	0.002	0.227	-0.001	0.002	0.678
Partner Effects X DERS	0.001	0.001	0.465	-0.003	0.003	0.292
Actor Effects X GEC	-0.002	0.001	0.168	-0.001	0.001	0.509
Partner Effects X GEC	0.001	0.001	0.143	0.002	0.002	0.366
Actor Effects X ADHD	0.017	0.065	0.791	-0.056	0.063	0.373
Partner Effects X ADHD	-0.044	0.035	0.208	-0.071	0.114	0.539

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

Table 6

Coupled Linear Oscillator Models: Clean Up Task

	Clean Up Task					
	Parent			Child		
Effect	Estimate (SE)	*t*	*p*	Estimate (SE)	*t*	*p*
F0 displ. (self)	-1.927 (0.06)	-34.83	<.0001***	-2.045 (0.067)	-30.66	<.0001***
F0 displ. (other)	-0.002 (0.024)	-0.07	0.947	0.229 (0.071)	0.21	<.0001***
F0 velocity (self)	0.013 (0.055)	0.24	0.809	0.012 (0.053)	0.22	0.824
F0 velocity (other)	0.025 (0.030)	0.83	0.405	0.114 (0.100)	1.14	0.253
F0 (self) X DERS	0.002 (0.003)	0.74	0.458	-0.001 (0.004)	-0.19	0.850
F0 (other) X DERS	0.001 (0.001)	0.93	0.350	0.001 (0.004)	0.25	0.800
F0 velocity (self) X DERS	-0.001 (0.003)	-0.23	0.816	0.000 (0.003)	0.07	0.940
F0 velocity (other) X DERS	0.0004 (0.002)	0.29	0.775	0.010 (0.006)	1.74	0.083^{+}
F0 (self) X GEC	0.003 (0.003)	1.08	0.281	-0.004(0.003)	-1.23	0.219
F0 (other) X GEC	0.001 (0.001)	0.54	0.589	-0.002 (0.004)	-0.57	0.567
F0 velocity (self) X GEC	-0.000 (0.003)	-0.06	0.955	-0.000 (0.002)	-0.14	0.891
F0 velocity (other) X GEC	0.001 (0.001)	0.56	0.578	0.007 (0.005)	1.48	0.140
F0 (self) X ADHD	0.027 (0.117)	0.23	0.814	0.146 (0.138)	1.05	0.293
F0 (other) X ADHD	0.128 (0.046)	2.80	0.005**	0.045 (0.147)	0.31	0.759
F0 velocity (self) X ADHD	-0.012 (0.114)	-0.10	0.918	-0.019 (0.110)	-0.18	0.861
F0 velocity (other) X ADHD	0.006 (0.063)	0.09	0.925	0.314 (0.206)	1.53	0.127

$^{+}p<.10$ $*p<.05$, $**p<.01$

Table 7

Coupled Linear Oscillator Models: Delayed Gratification Task

Delay Gratification Task						
	Parent			Child		
Effect	Estimate (SE)	*t*	*p*	Estimate (SE)	*t*	*P*
F0 displ. (self)	- 1.949 (0.069)	- 28.3	<.0001***	-2.00 (0.070)	-28.71	<.0001***
F0 displ. (other)	0.023 (0.024)	0.96	0.335	0.148 (0.069)	2.15	0.032*
F0 velocity (self)	0.045 (0.054)	0.82	0.411	0.002 (0.053)	0.03	0.973
F0 velocity (other)	.010 (0.032)	0.32	0.752	-0.048 (0.092)	-0.52	0.605
F0 (self) X DERS	0.003 (0.004)	0.90	0.368	0.003 (0.004)	0.71	0.477
F0 (other) X DERS	-0.001 (0.001)	-0.40	0.688	-0.003 (0.004)	-0.74	0.461
F0 velocity (self) X DERS	0.001 (0.003)	0.43	0.668	0.000 (0.003)	0.02	0.987
F0 velocity (other) X DERS	-0.01 (0.002)	-0.45	0.653	-0.003 (0.005)	-0.57	0.857
F0 (self) X GEC	-0.001 (0.003)	-0.35	0.727	0.001 (0.003)	0.25	0.800
F0 (other) X GEC	0.000 (0.001)	0.02	0.987	0.005 (0.004)	1.49	0.138
F0 velocity (self) X GEC	0.002 (0.003)	0.61	0.544	0.000 (0.002)	0.10	0.921
F0 velocity (other) X GEC	0.002 (0.001)	1.06	0.287	-0.001 (0.005)	-0.26	0.795
F0 (self) X ADHD	0.163 (0.149)	1.09	0.274	-0.114 (0.147)	-0.77	0.439
F0 (other) X ADHD	0.018 (0.055)	0.33	0.743	-0.064 (0.156)	-.041	0.679
F0 velocity (self) X ADHD	0.021 (0.121)	0.17	0.865	-0.082 (0.116)	-0.71	0.477
F0 velocity (other) X ADHD	0.010 (0.069)	0.14	0.890	0.133 (0.204)	0.65	0.514

$^{+}p<.10$ $^{*}p<.05$, $^{**}p<.01$

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