January 2018

Fathering And Toddler Emotion Regulation: Intergenerational Caregiving And Parasympathetic Processes

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FATHERING AND TODDLER EMOTION REGULATION: INTERGENERATIONAL CAREGIVING AND PARASYMPATHETIC PROCESSES

by

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DISSERTATION

Submitted to the Graduate School

of Wayne State University,

Detroit, Michigan

in partial fulfillment of the requirements

for the degree of

DOCTOR OF PHILOSOPHY

2018

MAJOR: PSYCHOLOGY (Clinical)

Approved By:

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Advisor Date

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Advisor Date

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ACKNOWLEDGEMENTS

First and foremost, I would like to acknowledge Dr. Erika Bocknek for believing in my abilities as a researcher, challenging me to grow, and providing me with a foundation for being a successful woman in academia. I would also like to acknowledge Dr. Doug Barnett, for granting me the opportunity to become a clinical psychologist, and for shaping my clinical and research perspective on child and family resilience. To my other committee members, Dr. Iheoma Iruka, Dr. Carolyn Dayton, and Dr. Christopher Trentacosta, thank you for your guidance and for sharing your expertise on this project. Finally, I am grateful for my family and friends for their limitless support on this journey. A special thanks to my friend and labmate, Hasti Raveau, for lifting me up when I needed it most.

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CHAPTER 1: INTRODUCTION

Emotion regulation is an essential component of adaptive childhood development that is rooted in complex and interacting environmental and biological systems (Denham et al., 2003; Kopp, 1992; Saarni & Crowley, 1990; Zeman, Cassano, Perry-Parrish, & Stegall, 2006). Deficits in these early regulatory abilities are related to poor socioemotional adjustment in childhood and psychopathology across the lifespan (Beauchaine, 2015). Caregivers play an integral role in promoting these competencies through their own displays of affect and their supportive parenting interactions, while individual psychophysiology influences the degree to which children are more or less sensitive to the caregiving environment (Morris, Silk, Steinberg, Myers, & Robinson, 2007). Existing literature has focused this inquiry on the mother-child dyad (Morris et al., 2007). Comparatively, much less is known of paternal contributions to emotion regulation, particularly within urban, socioeconomically disadvantaged families. Research strongly supports the cumulative toxicity of poverty-related stressors on child emotion regulation, and more broadly, on family functioning (Evans & Kim, 2007; Holtz, Fox, & Meurer, 2015; Trentacosta et al., 2008). Thus, synthesizing our knowledge of fathering, psychophysiology, and emotion regulation is particularly relevant for young children exposed to poverty-related conditions of risk, and consequently, may advance our conceptualization of resilient developmental trajectories.

The current study adopts a differential susceptibility framework to investigate how fathering influences toddler emotion regulation within a sample of low-income and primarily African American families. The differential susceptibility hypothesis posits that individual differences in developmental plasticity, such as psychophysiology, lead some individuals to be more susceptible than others to both positive and negative aspects of environmental influence (Belsky & Pluess, 2009). In this study, preliminary analyses descriptively report on the nature and frequency of emotion regulation strategies that toddlers employ while under stress. Next, a main effects model examines how differing dimensions of fathering (paternal emotion dysregulation, engagement following a stressor, responsivity during play) relate to toddler emotion regulation. To test a differential susceptibility hypothesis, a dynamic model of fathering is analyzed to examine if toddler respiratory sinus arrhythmia (RSA), an index of parasympathetic arousal, would influence the associations between fathering and toddler emotion regulation. The final and exploratory objective assesses associations among paternal RSA and key parent and child variables. Together, such inquiry will shed light on the intergenerational transmission of emotion regulation from father to child, as inventoried at multiple levels of analysis.

Emotion Regulation

Broadly, emotion regulation describes how individuals express and manage emotional experiences. As further defined by Calkins and Hill (2007), it encompasses “behaviors, skills, and strategies, whether conscious or unconscious, automatic or effortful, that allow children to modulate, inhibit, or enhance emotional expressions and experiences.” Appropriate mastery of these regulatory competencies has been associated with positive outcomes across domains of functioning, including social skills, sympathy, academic performance, and other prosocial behaviors (Denham, 1998; Eisenberg & Sulik, 2012; Graziano, Keane, & Calkins, 2007; Kochanska, Murray, & Harlan, 2000). Maladaptive patterns in regulation are observed as early as infancy, and seem to underlie most types of childhood and adult psychopathology (Beuachaine, 2015; Hayes, Wilson, Gifford, & Follette, 1996). A significant literature describes how maladaptive regulation, often referred to as emotion dysregulation, may manifest as aggression, hyperactivity, depression, and anxiety among other social, emotional, and behavioral problems (e.g. Alink, Cicchetti, Kim, & Rogosch, 2009; Beauchaine, 2015; Hayes et al., 1996).

Toddlerhood reflects a key developmental period during which to capture children's emerging emotion regulation competencies. It is understudied, as most published work in early childhood has focused on infancy or preschool-aged children (Moore & Calkins, 2004; Warren & Stifter, 2008). During toddlerhood, substantial shifts in cognitive, social, and regulatory abilities are occurring (Belsky, Friedman, & Hsieh, 2001; Campos, Campos, & Barrett, 1989; Sroufe, 1997). In line with these major shifts, emotion regulation strategies are also becoming increasingly varied and sophisticated. Early in infancy, emotion regulation is primarily dyadic in nature (gaze aversion/orientation directed at a caregiver, vocal activity), while self-soothing behaviors emerge at approximately one year of age. By toddlerhood, children employ both dyadic processes and independent coping behaviors to regulate, the latter of which includes strategies like distraction, orienting to an object, and fidgeting, among others (Cole, Martin, & Dennis, 2004; Goldsmith & Rothbart, 1996; Perry, Swingler, Calkins, & Bell, 2016; Premo & Kiel, 2016).

Poverty exposure has been identified as a salient risk for children's emotional dysregulation (Evans & English, 2002; Hardaway, Wilson, Shaw, & Dishion, 2012; Shonkoff et al., 2012). Chronic poverty, particularly in urban settings, is associated with unsafe neighborhoods, low-performing schools, violence, and family disruption (Cutrona, Wallace, & Wesner, 2006; Santiago, Wadsworth, & Stump, 2011). Racial-ethnic minority families, who are overrepresented in poverty, face additional social stressors, such as racism and discrimination (DuBois, Burk-Braxton, Swenson, Tevendale, & Hardesty, 2002; Harrell, 2000). Research strongly supports the toxicity of such additive poverty-related stressors (PRS) on socioemotional wellbeing, including emotion regulation (Duncan & Brooks-Gunn, 1997; Huston, McLoyd, & Garcia Coll, 1994; Kim et al., 2013). Despite these conditions of risk, many children in poverty are resilient, and are able to develop age-appropriate regulation strategies. Further inquiry into mechanisms that support children's adaptive regulation within at-risk samples *and* during significant points in development, is warranted (Raver, 2004).

Finally, despite the proliferation of research on emotion regulation over the past few decades, developmental science has struggled to establish gold standard methodology for construct measurement (Beauchaine, 2015; Cole et al., 2004). Existing methods of assessment range from parent-report measures to videotaped laboratory tasks. Laboratory tasks are preferred as they reduce the potential influence of reporter bias. Most commonly, young children's emotion regulation is captured by coding the child's level of distress during a frustrating or fear-inducing laboratory task. Though this type of measure clearly reflects emotional expression, some argue that it most accurately captures toddler distress or emotionality, which is not necessarily equivalent to regulation. Fewer studies code stressful laboratory tasks by specific coping and regulation strategies that the child utilizes while distressed (see Perry, Calkins, & Bell, 2015 for an example of this methodology). The latter methodology is considered to be a more optimal indicator of the construct, and will be employed in this study.

Fathering and Emotion Regulation

Most often, young children express emotions within the context of social relationships (Cole et al. 2004); thus, better understanding caregiver influence on child emotion regulation is key (Kopp, 1992; Thompson, 1994). A significant literature describes how mothers socialize emotion regulation through multiple, often interrelated processes, such as parenting practices and modeling (Morris et al., 2007). In comparison, fathering is considerably understudied. Early research on fathering often sought to quantify involvement of fathers (did they reside with their child; how many hours did they spend with their child), or assess paternal financial contributions to the family (Coles & Green, 2010; Lamb & Oppenheim, 1989). Such information about fathers was typically obtained indirectly via maternal report, and most study samples were comprised of middle or upper class families of European American descent. When nondominant groups, such as low-income and ethnic minority fathers were included, study findings were often interpreted through a euro-centric perspective. For example, a review of census data indicated that high rates of African American infants were born to unmarried parents, who did not share a home. It was surmised that low-income and African American fathers were uninvolved in raising their children (Coles & Green, 2010).

As the study of fathering has progressed over the past few decades, emphasis has shifted from maternal report of fathers' involvement, to examining how more diverse samples of fathers engage with their children (Fagan, Day, Lamb, & Cabrera, 2014; Kochanska, Aksan, Prisco, & Adams, 2008; Tamis-LeMonda & Cabrera, 2002). This emerging line of research underscores paternal contributions to child cognitive, emotional, and social development during infancy, middle childhood, and adolescence (Fagan et al., 2014). Culturally-sophisticated reexaminations of census-based studies have largely refuted the claim that African American fathers are not involved in their children's lives. Data supports that even nonresidential African American fathers have consistent relationships with their young children; in fact, nonresidential African American fathers, as compared to nonresidential European American and Hispanic fathers, are more likely to spend time with their children: 44% vs 26% and 17%, respectively (Bocknek, Hossain, & Roggman, 2014; Cabrera, Ryan, Mitchell, Shannon, & Tamis-LeMonda, 2008; McLanahan & Carlson, 2002). In addition, African American fathers, as compared to European American fathers, are also engaged in more equitable distributions of childcare responsibilities with mothers, such as feeding, bathtime, and bedtime (Cabrera, Hofferth, & Chae, 2011; Jackson, 1999).

Despite these broad advances in the field, focused study is needed to elucidate processes underlying fathering and child emotion regulation competencies, particularly within understudied and vulnerable samples, such as low-income and ethnic minority families (Kochanska, Aksan, Prisco, & Adams, 2008; Ramchandani & Psychogiou, 2009; Tamis-LeMonda & Cabrera, 2002). From the maternal parenting literature, we have learned that parents who are sensitive and responsive and calm while children are dysregulated, facilitate children's early success in socioemotional development (Cabrera, Shannon, & Tamis-LeMonda, 2007; Denham, 1993; Eisenberg et al., 2001; Eisenberg, Fabes, & Murphy, 1996). When parents are negative or dismissive of their children's emotional responses, children are less likely to develop adaptive coping (Snyder, Stoolmiller, & Wilson, 2003). Consistent with the mothering literature, low-income fathers' supportive and responsive interactions with their young children have been associated with toddler cognitive abilities (Jeon, Peterson, & DeCoster, 2013; Tamis-LeMonda, Shannon, Cabrera, & Lamb, 2004), language abilities (Tamis-LeMonda et al., 2004), and emotion regulation (Cabrera et al., 2007), beyond the influence of maternal engagement. Thus, it may be that the quality of fathering, particularly for socioeconomically disadvantaged families, reflects an important pathway to promoting resilient child outcomes (Cabrera et al., 2007; Martinez, DeGarmo, & Eddy, 2004; Tamis-LeMonda et al., 2004).

Some scholars argue that applying a mothering framework to fathering may fail to encourage the study of potentially unique contributions of fathers to child development. Evidence to support this supposition is found in the parenting sensitivity literature. Parenting sensitivity refers to one's ability to anticipate, understand, and respond to a child's needs (Tamis-LeMonda, Damast, Baumwell, & Bornstein, 1996). Sensitivity during parent-child interactions has consistently emerged as a salient predictor of child socioemotional outcomes across development

(Bakermans-Kranenburg, Van Ijzendoorn, & Juffer, 2003; Van Ijzendoorn, Juffer, & Duyvesteyn, 1995). However, several studies have found that fathers engaged in fewer sensitive (Volling, McElwain, Notaro, & Herrera, 2002) and soothing (Dayton, Walsh, Oh, & Volling, 2014) interactions with their infants, as compared to mothers. Other studies have found that father sensitivity relates to attachment security (Eiden, Edwards, & Leonard, 2002; Lucassen et al., 2011), while some have not (Braungart-Riecker, Garwood, Powers, & Wang, 2001; Volling et al., 2002).

To advance the study of fatherhood, it may be important to expand models of parenting practices to account for potentially unique ways that fathers influence child development; play relationships have been implicated (Adamsons & Buehler, 2007; Bocknek et al., 2014; Lamb & Lewis, 2013). The *activation relationship hypothesis* posits that fathers provide young children with exposure to emotionally arousing play, which is then paired with the practice of regulating this arousal through dyadic interactions (Paquette, 2004; Roggman, Boyce, Cook, Christiansen, & Jones, 2004). Active play may represent a uniqueness of fatherhood, as fathers are more likely to engage in this type of play with their children than are mothers (Bocknek et al., 2016; Carson et al., 1993; MacDonald & Parke, 1986) and mothers' engagement in active play may not always have the same positive effects on children (Volling et al., 2002). Together, this line of work provides preliminary support for the notion that play, and playfulness, may be a distinctive facet of fathering (Bocknek et al., 2014; Bocknek et al., 2016; Grossmann, Grossmann, Kindler, & Zimmermann, 2008; Volling et al., 2002).

In addition to parenting practices, parents' own modeled expression of emotion and emotion regulation implicitly teaches children how they should respond to stressors that they encounter (Morris et al., 2007). Parents with an effective approach to emotion regulation have a repertoire of psychological and behavioral resources that help them adaptively respond to stressors, while parents who have not developed effective regulation strategies may have a limited, rigid, or over reactive response to stress. Although it has been theorized that emotion regulation is transmitted from parent to child through modeling, or learning from observation (Bandura, 1977; Dix, 1991), few studies have directly assessed this hypothesis (Bariola et al., 2012; Crandall, Deater-Deckard, & Riley, 2015; Han & Shaffer, 2012). These studies have been conducted with samples of school-age children utilizing self-report methodology; most identified significant associations between mother and child emotion regulation (Bariola et al., 2012; Crandall, et al., 2015; Han & Shaffer, 2012). One study included both mothers and fathers, but found that only maternal emotion regulation significantly predicted child regulation (Bariola et al., 2012).

Additional evidence for the importance of parent modeling, though indirect, can be found in the parental psychopathology literature. Given that emotion dysregulation underlies most forms of psychopathology (Beauchaine, 2015), it is likely that parents with this symptomatology may have difficulty with regulating and expressing their affect adaptively when they are in proximity to, or interacting with their children. Such work, most commonly examining parental depression and anxiety disorders, has established that maternal and paternal psychopathology undermines child socioemotional and behavioral functioning (Silk, Shaw, Skuban, Oland, & Kovacs, 2006). To summarize literature related to parent modeled affect, integrating both parent emotion regulation and parent psychopathology literatures: findings are, at this point, inconclusive. Though there is theoretical justification and preliminary empirical support, additional study is needed to evaluate if modeled paternal emotion regulation is a meaningful predictor of toddler emotion regulation.

Utilizing the preceding literature as a guide, the current study inventoried fathering across three differing contexts in a sample of low-income and primarily African American families. First, consistent with methodology that has been utilized to study mothering, fathers' engagement with their child following a stressful task was examined. Next, to incorporate the theory that play relationships may be a uniquely important aspect of fathering, fathering during a play task was also measured (Paquette, 2004; Roggman et al., 2004). Finally, and in addition to parenting practices, parents likely model emotion regulation for their children (Bandura, 1977; Morris et al., 2007), thus, a measure of paternal emotion dysregulation was also included.

Respiratory Sinus Arrhythmia as an Index of Differential Susceptibility

Parenting is influential in shaping child development. In addition to this direct association, multiple theories highlight the dynamic, transactional associations that exist between parents and their children (Belsky & Pluess, 2009). A child's individual physiology, genetic profile, and indices of biological regulation may all function as protective or vulnerability factors for child development, as they affect how children react and respond to the caregiving environment. The differential susceptibility hypothesis purports that unique differences in developmental plasticity lead some individuals to be more susceptible than others to environmental influence (Belsky & Pluess, 2009). In other words, children with certain physiological profiles may be more influenced by negative aspects of the caregiving environment, and simultaneously, more able to benefit from supportive aspects of the caregiving environment. In this study, children's respiratory sinus arrhythmia (RSA), a measure of parasympathetic nervous system (PNS) regulation of cardiac activity, is examined as a marker of differential susceptibility.

Housed within the autonomic nervous system (ANS), which functions to regulate unconscious biobehavioral response (Beauchaine, 2015), the parasympathetic nervous system promotes homeostasis and regulates response to stress (Beuchaine, 2015; Perry et al., 2015; Porges, 1995). As a measure of parasympathetic arousal, RSA specifically inventories variation in heart rate as it occurs at the frequency of breathing, which is controlled by the vagus nerve. The vagus nerve is the 10th cranial nerve and its activity is commonly referred to as vagal tone. Porges (1995), a researcher known for preeminent Polyvagal Theory, stated that there are two branches of the vagus nerve--myelinated and unmyelinated. He described the myelinated vagus as the *vagal brake* as it inhibits the impact of the sympathetic nervous system on the heart; its activation promotes slowing of the heart, self-soothing and calm states. Removal of the *vagal brake* is associated with increased heart rate which facilitates mobilization of physiological resources, task engagement, and active coping.

RSA has been inventoried in multiple ways, perhaps most commonly by computing resting (or baseline) RSA. Resting RSA is collected during a no/low-stress laboratory task, and is conceptualized as a trait-like indicator of stress vulnerability that reflects one's ability to maintain homeostasis where there is no threat or challenge present. Higher levels of RSA at baseline are believed to be when the *vagal brake* is highest, meaning that the body is in a calm state. Elevated resting RSA has been associated with a multitude of better psychological outcomes across the lifespan, such as social competence, empathy, sustained attention, attachment security, and executive function, among others (Beauchaine, 2015; Kidwell & Barnett, 2007). Low RSA at baseline is thought to reflect reduced *vagal brake*, again, signifying increased stress vulnerability and that the body is mobilized for stress. Lower resting RSA has been linked with numerous poor psychological outcomes, including internalizing and externalizing problems, anger, depression, and anxiety (Beauchaine, Gatzke-Kopp, & Mead, 2007; Shannon, Beauchaine, Brenner, Neuhaus, & Gatzke-Kopp, 2007; Skowron, Cipriano-Essel, Gatzke-Kopp, Teti, & Ammerman, 2014).

In addition to resting RSA, studies have examined fluctuation in RSA across task demands (reactivity), which is thought to be more reflective of one's capacity for emotion regulation and coping (Beauchaine, 2001; Calkins, 1997; Porges, 1995). It is theorized that elevated RSA at rest, and suppressed (decreasing) RSA during a stressful task (high suppression) would reflect adaptive regulatory abilities and socioemotional competence (Porges, 1995). Conversely, low RSA at baseline and a lack of RSA suppression following a stressful task (low suppression) is thought to be related to poor emotion regulation. These expected associations have been supported by several published studies with both children and adults (Beauchaine et al., 2007; Brooker & Buss, 2010). While there is some debate as to whether high or moderate levels of suppression are most adaptive (Calkins, 1997; Calkins, Graziano, & Keane, 2007; Gazelle & Druhen, 2009), studies generally agree that low suppression is a risk for poor emotion regulation and other problematic socioemotional outcomes (El-Sheikh & Hinnant, 2011; Graziano et al., 2007).

A small literature has inventoried maternal RSA within the context of parenting; these findings generally demonstrate that suppression of maternal RSA (decreasing RSA) is associated with more positive, sensitive caregiving during stressful laboratory tasks with infants (Mills-Koonce et al., 2007; Moore et al., 2009) and preschool aged children (Skowron, Cipriano-Essel, Benjamin, Pincus, & Van Ryzin, 2013). To the best of our knowledge, only one published study has examined paternal RSA and parenting (Blandon, 2015). In a study of fathers, mothers, and their young children (ages 2-5), Blandon (2015) found that resting paternal RSA was associated with fathers' supportive reactions to children's negative emotions. This effect was not found for mother's RSA and supportive parenting. However, paternal RSA was also related to maternal responses to child negative emotion. These findings suggest that fathers' psychophysiology has an important bearing on his caregiving in times when the child is distressed. Together, literature suggests that parents' RSA is associated with parenting, however, these findings are preliminary, dependent on characteristics of the sample and nature of the laboratory tasks, and have not often been studied with fathers.

The Current Study

The primary purpose of this study was to examine paternal contributions to young children's emotion regulation, among families in poverty. This study is guided by a differential susceptibility framework, which posits that individual differences in developmental plasticity, such as psychophysiology, lead some children to be more susceptible than others to the caregiving environment (Belsky & Pluess, 2009). Thus, toddler resting RSA and RSA reactivity were included in relevant models to determine if toddler parasympathetic arousal influenced the effects of fathering on toddler emotion regulation. Specific study aims and hypotheses follow:

Aim One: The first aim of this study will descriptively inventory the nature and frequency of emotion regulation strategies that toddlers employ while under stress.

- Hypothesis 1a: It is expected that children will utilize a range of emotion regulation behaviors during a stressful task.
- Hypothesis 1b: It is hypothesized that child emotion regulation behaviors will be able to be represented by a single, overarching score

Aim Two: The second aim will test a main effects model to examine how differing dimensions of fathering (paternal emotion dysregulation, engagement following a stressor, responsivity during play) relate to toddler emotion regulation.

- Hypothesis 2: More optimal dimensions of father emotion regulation and parenting will significantly and positively predict toddler emotion regulation behaviors.

Aim Three: To account for the influence of children's psychophysiology, the third aim will test a dynamic model of fathering to determine if toddler respiratory sinus arrhythmia (RSA), an index of parasympathetic stress vulnerability, buffers or amplifies the associations between fathering and toddler emotion regulation. See Figure 1.

- Hypothesis 3a: Paternal dysregulation will predict toddler emotion regulation. Child RSA will moderate the effect of paternal dysregulation on toddler emotion regulation.
- Hypothesis 3b: Paternal engagement following a stressor will predict toddler emotion regulation. Toddler RSA will moderate the effect of paternal engagement on toddler emotion regulation.
- Hypothesis 3c: Paternal responsivity during play will predict toddler emotion regulation. Child RSA will moderate the effect of paternal engagement on toddler emotion regulation.
- Hypothesis 3d: It is expected that the model including paternal engagement during play as the independent variable (Hypothesis 3c) will have a larger effect size as compared to the model that includes paternal responsivity following a stressor (Hypothesis 3b).

Aim Four: The fourth study aim analyzes associations among paternal RSA and key parent and child variables. This aim is considered to be exploratory, as the sample size for paternal RSA is relatively low (n = 57), and including this measure in primary models may limit power to detect meaningful differences. However, studying paternal RSA and its potential associations with both father and child factors contributes to a more comprehensive understanding of the transmission of ER from parent to child. Thus, paternal RSA will be analyzed separately.

- Exploratory Hypothesis 4: There may be significant associations between paternal RSA and key father (emotion dysregulation, engagement following a stressor, responsivity during play) and child (RSA, emotion regulation) variables.

CHAPTER 2: METHOD

Participants

The current study describes data from 92 fathers, mothers, and their toddlers (n = 56 boys) enrolled in the Toddlers' Emotion Development in Young Families (TEDY) Study (PI: Bocknek). Data were collected as part of a broader study examining family resilience among urban, low SES children and their primary caregivers. Consistent with the aims of this manuscript, the following sample description focuses on fathers and toddlers; see Table 1 for additional sample information, including demographic information for mothers. Participants were biological fathers (*n*=85), step-fathers (*n*=6), and one adoptive father (*n*=1). Fathers ranged in age from 20 to 52, and were 31 years of age on average (SD = 8.05). Most fathers identified their ethnic background as African American (90%). Among the fathers in the study, 79% lived in the same house as their child (resident fathers); 86% were in a committed romantic relationship. Most families reported a yearly income < $15,000 (67%).

Procedure

This study was reviewed and approved by the Institutional Review Board at Wayne State University (IRB). To be eligible for recruitment in the TEDY study, participants had to be the biological mother with legal custody of a child between the ages of 24-31 months, over the age of 18, and fluent in English. They also needed to participate in the study with a secondary caregiver of the child. The current study required that the participating secondary caregiver was the child's father. Fathers did not have to reside with the child, nor was it required they be in a romantic relationship with the child's mother. Families were not eligible to participate if their child was diagnosed with a developmental disability; this was determined via maternal report.

Families were primarily recruited from two Women, Infants, and Children (WIC) centers located in Detroit, Michigan. Trained research assistants approached women and families in the WIC center waiting rooms to inform them about the study and to screen them for eligibility. Study flyers were posted at WIC centers, as well as at nearby childcare centers, Children's Hospital of Detroit, local grocery stores, and community centers. Women who responded to the flyer were screened for study inclusion and exclusion criteria via telephone.

Families who agreed to participate in the study scheduled a laboratory visit with research assistants. The study visit had a duration of approximately four hours per family. Directly prior to participation, informed consent was obtained for each caregiver, as well as the child. During the first two hours of the visit, families engaged in a series of dyadic and triadic videotaped interactions and laboratory tasks. Throughout these observations, family members were each connected to Mindware software (Biolab 2.5; Mindware Technologies, Columbus, OH) to assess respiratory sinus arrhythmia (RSA), among other physiological indicators of functioning. During the latter two hours of the visit, caregivers met individually with a research assistant to provide self-reported information related to family demographic information, paternal emotion dysregulation, and maternal depression.

Descriptive Measures

Demographic Information. Family demographic information was reported by both father and mother. Information was obtained regarding parental age, ethnicity, generation status, education, income, marital status, father's residential status, family composition, as well as child age and gender.

Toddler Emotion Regulation

Regulatory Behaviors. Toddler emotion regulation behaviors were inventoried during the Attractive Toy Behind the Barrier (TBB) task. TBB is a task drawn from the Laboratory Temperament Assessment Battery (LabTAB, locomotor version; Goldsmith & Rothbart, 1999). The TBB task is a 4.5-minute episode, where a toy taken is away from the child and placed behind a see-through barrier three times. The task is designed to elicit frustration and other negative responses from the child.

Three research assistants were trained to code this task using a coding system that was developed based other systems previously used to measure regulation in young children (Calkins, 1997, Calkins & Johnson, 1998, & Stifter & Braungart, 1995). The following toddler behaviors were scored for presence/absence in 10-second intervals: 1) attention bid: talking to parent(s) or research assistants, reaching out toward parents or research assistants; 2) social referencing: looking to parent(s) or research assistants; 3) distraction: self-comforting thumb-sucking, hair twirling, or other auto-manipulative behavior; 4) physical action: banging, kicking, throwing, hitting the object of frustration; 5) interaction with task object: looking at, touching, or manipulating task object; and 6) cognitive reappraisal: child looks quizzically at parent(s) or research assistants. These scores were coded and summed across 10-second intervals. There were a total of 18 epochs while the toy was behind the barrier and a total of 9 epochs when the child had access to the toy. Thus, it would be possible for all raw emotion regulation behavior subscales to range from 0-18 while the toy was behind the barrier and 0-9 while the child was able to play with the toy.

To establish inter-rater reliability, 20% of videos were double coded. The ICC for the inter-rater coding reliability for these scales ranged from r = .84 to r = .93, indicating acceptable to good reliability.

Fathering

Emotion Dysregulation Paternal emotion dysregulation was inventoried using the Emotional Dysregulation Scale (EDS). The EDS is a 24-item self-report measure of adult emotion regulation competencies. The EDS was adapted from the clinician-rated Affect Regulation and Experiences Q-sort Questionnaire (Conklin, Bradley, & Westen, 2006; Zittel-Conklin & Westen, 2005). All items are scored on a 7-point Likert scale ranging from Not True to Very True. Items assess three domains of dysregulation, including 1) emotional experiencing (*My emotions sometimes spiral out of control*), 2) cognition (*When I'm upset, I have trouble seeing or remembering anything good about myself*) and 3) behavior (*When my emotions are strong, I often make bad decisions*). A total dysregulation score is calculated by summing all items. The EDS demonstrated high internal consistency (α = .97).

Engagement Following a Stressor. Paternal engagement was assessed during the "Bubbles Task." The bubbles task was a 3-minute triadic episode where parents were asked to play with bubbles with their child. This task was directly preceded by a series of parent-child separations. During the separations, children were left for 2 minutes in a room with toys and a member of the interview team (who did not speak or interact with the children); parents would then enter the room and be with their children for two minutes, and then leave the room again for another two minutes. At the end of the second separation, parents entered the room with bubbles to comfort their child.

The bubbles task was videotaped and later coded by a team of three independent coders using the Family Reunion and Play Procedure Microcoding System (unpublished coding manual, McGoron & Bocknek). Approximately 25% of videos were double coded to ensure reliability. Mangold Interact Software was used for coding and to determine interrater reliability for all codes; final reliability was K = .78. The code utilized in the present study was *engagement*. Engagement reflected the percentage of the task that the father was engaged with the child.

Responsiveness During Play. Parenting responsiveness was obtained during a dyadic, father-child play task. The father and child received three numbered bags with the numbers “1”, “2”, and “3” on them and were asked to play with them in numerical order for 10 minutes. The bags include a bean bag toss game, a puzzle, and medical kit. The task was videotaped and coded using the Piccolo coding system (Roggman, Cook, Innocenti, & Jump Norman, 2009). The PICCOLO (Roggman et al., 2009) consists of 29 items grouped in four domains of positive parenting strategies. Observers rated the frequency and intensity parents exhibited those strategies, using a scale of 0 (*not at all there*), 1 (*barely there*), and 2 (*mostly there*). Responsiveness consists of seven items that indicate how sensitive the father is to the child’s cues. Examples include “Responds to child’s emotions,” and “Replies to child’s words or sounds.”

Three research assistants were trained by watching 5-minute training videos, and then compared their scores to the established codes for the videos. Coders started with 2-4 items (half a domain), then 7-8 items (full domain), then 14-15 items (2 domains), then finally practiced with all 29 items (4 domains). Coders then practiced what they learned in training with 1-2 videos of the Three Bags Task per week, and routinely met to discuss discrepancies between individual items, domains, and items across videos. All videos were double coded. The ICC for the inter-rater coding reliability for responsiveness was .88, indicating good reliability.

Parasympathetic Nervous System (PNS) Activation

Respiratory Sinus Arrhythmia (RSA). Physiological data for father and child were obtained using the Mindware 3000A Wireless System. Disposable electrocardiogram (ECG) electrodes were placed over the participants' right clavicle and the left side below the ribcage (the recording electrodes), and on the right side below the ribcage (the grounding electrode). A respiratory effort belt was placed below the diaphragm to monitor and control for respiration throughout the session. Electrodes were connected to handheld monitors; monitors were clipped to the father's belt or placed in a backpack worn by the child. The monitors were wirelessly connected to a desktop computer in the adjacent observation room. Interbeat interval data was edited by trained coders for artifacts due to father and child movement. RSA magnitude was calculated as the natural logarithm of the variance of heart period within the frequency bandpass related to respiration (0.24–1.04 Hz for children and 0.12-0.40 for adults) (Fracasso, Porges, Lamb, & Rosenberg, 1994) using a software package (Biolab 2.5; Mindware Technologies, Columbus, OH).

Resting RSA reflects a stable trait-like indicator of physiological arousal. Resting RSA for both father and child was collected during a low-stress, enjoyable family book sharing task. Epochs were four, 60-second intervals. These four epochs were averaged to create separate resting RSA score for fathers and children. A child RSA reactivity score was also computed. To create this score, RSA was coded in three, 60-second intervals during the Attractive Toy Behind the Barrier (TBB) task. These three epochs were averaged to create a TBB RSA score. The TBB RSA score was then regressed on resting RSA; standardized residuals were extracted to create a reactivity score (see Cho, Philbrook, David, & Buss, 2017). Thus, the reactivity score based on standardized residuals accounted for resting RSA. Lower scores reflect greater RSA suppression from baseline to the TBB task.

Four trained, independent research assistants coded each RSA file; 20% of files were double coded to establish reliability. The ICCs for the inter-rater coding reliability for paternal RSA ranged from .96 to .98, indicating acceptable to good reliability. The ICC for the inter-rater coding reliability for toddler RSA ranged from .95 to .98, indicating acceptable to good reliability.

Covariates

All analyses, when applicable, controlled for variables that have been shown by existing literature to influence child socioemotional development. Preliminary analyses evaluated child sex, maternal depression, toddler baseline state directly prior to the Attractive Toy Behind the Barrier task, and demographic risk as covariates to consider for inclusion in study models. All covariates were measured as part of the larger study.

Maternal Depression. The Center for Epidemiologic Studies-Depression Scale (CES-D short form; Radloff, 1977) was used to measure symptoms of depression that mothers had experienced during the week before study participation. The instrument includes 11 items, which are summed to yield a total score reflecting an index of depressive symptomatology. A cutoff score of 10 or higher on the CES-D short form suggests clinical levels of depression. The internal reliability of CES-D was in the acceptable range (α = .73).

Toddler Baseline State. Behavioral coding for the Attractive Toy Behind the Barrier task (LabTAB; Goldsmith and Rothbart, 1999) also included a *baseline state* score; the toddler's state prior to the beginning of the episode was coded as 1= tired/drowsy, 2= alert/calm, 3= alert/active, 4= fussy, and 5= crying. ICC for the inter-rater coding reliability for these scales was r = .81, indicating acceptable reliability.

Demographic Risk. A cumulative demographic risk index, inspired by previous work by Sameroff et al. (1993), reflected the summed presence of socio-demographic risk indicators known to undermine parenting and child outcomes: (1) low income (yearly family income less than $20,000) (2) young parent age at child's birth (< 23 years); (3) low educational attainment (high school graduate and less), (4) father residential status (father does not reside in child's home), and (5) heavy caregiving burden (more than four children in the household). Families received a score of 1 for each indicator if present or a score of 0 if the indicator was absent. In this sample, demographic risk scores ranged from 1-5 (M = 1.56, SD = 1.01).

Power and Sample Size

Power analyses were conducted to determine if planned analyses were appropriate for the existing sample with alpha (.05), effect size (.15) and power (.80), for linear multiple regression with four predictors. Results confirmed that a minimum sample size of 85 cases was appropriate to examine study aims (G*Power 3 program; Faul, Erdfelder, Buchner, & Lang, 2009).

Missing Data

Missing data in this study were attributed to either: 1) planned missing design (PM), or 2) data missing at random (MAR).

This study employed a planned missing (PM) design for all self-report data, which was implemented by randomly assigning participants to one of three assessment batteries that had intentionally missing items (Graham, Hofer, & MacKinnon, 1996; Graham, Taylor, Olchowski, & Cumsille, 2006; Schenker, Katzoff, & Johnson, 2006). The goal of a PM design is that it increases the number of study constructs, while reducing response burden on the participant. Three forms were created, with each containing a subgroup of the total number of items included. Participants were assigned one of the three created forms. Each form was composed of an X block, which consisted of 25% of items from each measure that were considered critical items, plus one of the three remaining blocks (A, B, or C). Thus, each participant completed a survey that was 50% shorter than the original. In the current study, this procedure was conducted for the Emotion Dysregulation Scale completed by fathers (EDS; Conklin et al., 2006; Zittel-Conklin & Westen, 2005), and the depression scale completed by mothers (CES-D; Radloff, 1977). Missing data as a result of the PM design were imputed using the principal component auxiliary variable (pcAux) method outlined by Howard, Rhemtulla, and Little (2015).

Furthermore, among the 92 families included in these analyses, not all participants had completed data for all measures. Among the full sample of participants (N = 92), the following percentage of data were missing per variable: demographic risk (< 1%, n = 1); toddler emotion regulation and baseline state (12%, n = 11); paternal engagement following a stressor (27%, n = 24); paternal responsivity during play (30%, n = 27); toddler RSA (20%, n = 18); father RSA (38%, n = 35). Because > 30% of father RSA was missing, it was decided to exclude this variable from primary regression models. All missing data were reviewed to explore the mechanisms related to missingness. In most cases of missingness, data were not obtained due to equipment failure (videos were not recorded, Mindware HR software lost connectivity, HR leads became loosened/detached from a participant). On far fewer occasions, families had to leave before completing all study tasks, tasks were administered by research assistants incorrectly, or participants refused to complete a given task.

Little's MCAR test was conducted to determine if missingness could be considered missing at random (MAR) or if it was missing not at random (MNAR). MNAR indicates that there is a pattern to missingness, and data should not be imputed. Results supported that data in this sample were MAR, as indicated by a nonsignificant chi-square value (X^2 = 72.37, DF = 80, p = .72).

Further, missing data did not relate to any key father or child variables (all *t's* <1.71, *p's* > .05). Multiple imputation is the preferred method for handling missing data (Graham, 2009). These values were imputed using the SPSS multiple imputation MCMC algorithm. This method uses the fully conditional specification method, which imputes data using linear regression for continuous variables. Graham & Schafer (1999) demonstrated that multiple imputation performs well in small samples (as low as N = 50), with many predictors, and with as much as 50% missing data. Reported results reflect pooled estimates from 10 imputed datasets.

Analytic Plan

All data were analyzed using SPSS 24. Prior to utilizing parametric statistics, descriptive analyses were conducted on all study variables to examine normality, means, standard deviations, range, skew, kurtosis, and bivariate correlations. To determine whether proposed covariates (child gender, maternal depression, toddler baseline state, and demographic risk) should be included in subsequent analyses, bivariate correlations and independent-samples t tests were conducted.

The following analyses were conducted to address each study aim. The first aim examined the nature and frequency of emotion regulation strategies that toddlers employed while under stress. To address this aim, descriptive analyses and common factor analysis were conducted on toddler emotion regulation codes to guide the reduction of these variables into a single, representative, toddler emotion regulation score. Common Factor Analysis (FA), also known as Principal Axis Factoring, is a data-reduction methodology that theoretically aims to identify latent variables, or factors, that have causal influence on observed variables. It is a considered to be a conservative method, as it does not assume perfect reliability of analyzed variables.

The second aim tested a main effects model to examine how differing dimensions of fathering (paternal emotion dysregulation, engagement following a stressor, responsivity during play) related to toddler emotion regulation. To address this objective, a hierarchical linear regression was conducted.

The third aim tested a dynamic model of fathering, to examine whether toddler RSA moderated the associations between fathering constructs and toddler emotion regulation. A series of six moderated hierarchical linear regressions were conducted to assess this aim. The dependent variable across all six models was toddler emotion regulation. Fathering independent variables were emotion dysregulation, engagement following a stressful task, and responsiveness during play. Toddler resting RSA and RSA reactivity were examined as moderators in separate models. An example of each step of the regression is: Step 1) covariates, toddler RSA, and paternal dysregulation; Step 2) the 2-way interaction term (paternal dysregulation x toddler RSA). Moderation analyses were conducted using Hayes PROCESS macro for moderation (model 1; Hayes, 2012). Significance for the moderation models was tested with 1,000 bootstrapped samples to estimate 95% bias-corrected confidence intervals. Significant moderation effects were probed using estimates of simple slopes at low (one SD below the mean), medium (the mean), and high (one SD above the mean) levels of the continuous moderator variable.

Finally, the fourth aim analyzed associations among paternal RSA and key study variables. A series of partial correlations identified potential associations between paternal RSA and fathering indicators (emotion dysregulation, engagement, sensitivity) and child factors (RSA, emotion regulation behaviors).

CHAPTER 3: RESULTS

Preliminary Analyses

Prior to analyses, data were screened for accuracy of input, outliers, and normality. Accuracy of input was established by the plausibility of means and standard deviations for each variable. Univariate and multivariate outliers were screened by computing standardized z scores at the univariate level and computing Mahalanobis distance scores at the multivariate level. Data were also screened for skewness and kurtosis. Assumptions of hierarchical linear regression were met through establishing linearity between the independent and the dependent variables, establishing multivariate normality using histograms and a fitted normal curve, evaluating for multicollinearity, and employing scatterplots to evaluate homoscedasticity. Following these data screening steps, results demonstrated that two key variables had a slight positive skew. However, skew values fell below the two-point cut-off suggested by West, Finch, and Curran (1995); thus, statistical transformation of these variables was not warranted.

Table 2 presents the means, standard deviations, and the bivariate correlations among primary study variables. Higher toddler emotion regulation was significantly and positively related to toddler RSA, and significantly negatively correlated with father emotion dysregulation, toddler baseline state directly preceding the TBB task, and maternal depression. Toddler resting RSA was significantly negatively associated with father emotion dysregulation. Fathers' engagement with their children following a stressor was positively associated with maternal depression. Fathers' responsivity during play was significantly and negatively correlated with demographic risk. Finally, toddler baseline state was significantly and positively associated with maternal depression.

Next, proposed covariates were evaluated for inclusion into study models. Per results from the bivariate correlation matrix (Table 2), maternal depression, toddler baseline state, and demographic risk all had statistically significant associations with at least one key study construct. To account for their statistical influence, these three variables were included in subsequent analyses as covariates. Next, a series of independent-samples t tests were conducted to evaluate toddler sex as a covariate. Results revealed that sex did not significantly differentiate means of key study variables. Thus, toddler sex was not added to subsequent models as a covariate, see Table 3.

Aim 1: Descriptive Inventory of Toddler Emotion Regulation

A series of analyses were conducted to describe toddler emotion regulation in this sample, with the overarching goal of creating a meaningful emotion regulation composite score. There were a total of six coded strategies: 1) attention bid; 2) social referencing; 3) distraction; 4) physical action; 5) interaction with task object; and 6) cognitive reappraisal. These behaviors were coded during the TBB task (Goldsmith and Rothbart, 1999) separately when a) the toy was placed behind the barrier (distressing for the child); and b) the child was able to play with the toy (less distressing for the child). The first set of descriptive analyses sought to compare the frequency of emotion regulation behaviors used when a) the toy was behind the barrier; versus b) the child played with the toy. A series of independent-samples t tests revealed that on average, children engaged in more emotion regulation behaviors when the toy was behind the barrier (Table 4). Because these strategies were utilized more frequently while the toy was behind the barrier, only those codes were considered for inclusion in the emotion regulation composite score.

Next, average use of emotion regulation strategies over the course of the task are presented in Figure 2. Toddlers most often employed interaction with the task object (*M* = 17.09, *SD* = 7.51) social referencing (*M* = 16.83, *SD* = 6.75), and distraction (*M* = 11.21, *SD* = 7.14). Toddlers were least likely to engage in physical actions (*M* = 2.73, *SD* = 4.35) and cognitive reappraisal (*M* = .14, *SD* = .83). When examining the variety of strategies used by each child, results revealed that toddlers used between two to six of the coded emotion regulation strategies throughout the task. In this sample, 39% (n = 36) of children used 4 different strategies, 35% (n = 33) used 5 strategies, 19% (n = 18) used 3 strategies, and 6% (n = 5) used either 3 or all 6 coded strategies.

Bivariate correlations were conducted to examine intercorrelations among emotion regulation strategies; results are presented in Table 5. Attention bid was significantly and positively related to social referencing (r = .45, p = .00), and had trend level associations with interaction with object (r = .27, p = .063) and cognitive reappraisal (r = .32, p = .059). Social referencing was significantly and positively associated with distraction (r = .37, p = .001). Distraction was significantly and negatively correlated with physical action (r = -.29, p = .012).

Factor analysis (FA) with varimax rotation and principle axis factoring was performed to reveal the underlying factor structure of emotion regulation. Prior to FA, all variables were standardized. Three factors emerged (Table 6), with the first factor accounting for 29.76% of the total variance of the measured variables. Three of six emotion regulation variables were retained in the first factor: attention bid F = .34, social referencing F = .87, and distraction F = .60. All factor loadings were above the cutoff convention of .30 (Cattell, 2012).

The preceding set of analyses, including descriptive information, t tests, bivariate correlations, and factor analysis, was taken into consideration when creating a single emotion regulation score. Ultimately, it was decided to employ the first factor of the FA as the emotion regulation dependent variable, which was computed by saving weights of the regression factor 1 scores as a new variable. There was both a theoretical and statistical basis for excluding physical action, cognitive reappraisal, and interaction with task object from the emotion regulation score. Physical action was not correlated in expected directions with the other emotion regulation strategies. It is possible that the coded behaviors (ie. pounding the table, squeezing out of the high chair) may be more reflective of distress than attempts to regulate (Calkins & Johnson, 1998). The cognitive reappraisal code will also be excluded from the emotion regulation score. There was a very low occurrence of using this strategy in the sample; on average fewer than 1% of toddlers employed cognitive reappraisal. Finally, interaction with objects was not included. Although interaction with the task object was the most commonly performed strategy while a) the toy was behind the barrier (M = 17.09, SD = 7.51), it was also the most common behavior coded when b) the child had access to the toy (M = 11.40, SD = 2.33). This suggests that interacting with the object (by looking at it or playing with it) may not be a strategy that is unique to coping during times of distress.

Aim 2: Father Emotion Regulation, Parenting, and Toddler Emotion Regulation

Regarding the first model outlined in Aim 2, it was hypothesized that less optimal dimensions of father emotion regulation and parenting would predict toddler distress. Demographic risk, toddler baseline task behavior, maternal depression, and toddler resting RSA were entered as covariates in Step 1 of the regression. Paternal dysregulation, paternal engagement following a stressor, and paternal responsivity during play were entered in Step 2.

Results indicated that the overall model accounted for 32.6% of variance in toddler emotion regulation, $F(7,84) = 5.81$, $p = .001$. Among the covariates, maternal depression ($b = -.14$, $SE = .03$, $p = .000$) was related to lower toddler regulation; a trend-level association was noted with toddler resting RSA ($b = .22$, $SE = .11$, $p = .055$). In regard to indices of fathering, lower paternal dysregulation ($b = -.01$, $SE = .004$, $p = .030$) and more engagement following a stressor ($b = .02$, $SE = .01$, $p = .003$), significantly predicted toddler emotion regulation. Responsivity during play did not emerge as a significant predictor ($b = -.01$, $SE = .05$, $p = .831$,), see Table 7.

Aim 3: Primary Study Regression Analyses

To evaluate the third aim, a series of six simple moderation analyses using the PROCESS macro were conducted to examine the moderating effect of toddler RSA on the relationship between fathering (emotion dysregulation, engagement following stress, and responsiveness during play) and toddler emotion regulation. All models controlled for demographic risk, maternal depression, and toddler baseline state prior to the emotion regulation task. Models A1, B1, and C1 included toddler resting RSA as a moderator. Models A2, B2, and C2 employed toddler RSA reactivity as the moderating variable.

Model A1 Independent variable: paternal dysregulation; moderator: resting toddler RSA. The overall model was significant, $F(6,85) = 4.93$, $p = .000$, $R^2 = .26$. Toddler resting RSA significantly moderated the association between paternal dysregulation and toddler emotion regulation (b =-.01, se = .01, 95% CI = -0.02 to -0.001) as indicated by the confidence interval excluding a 0.

To probe the interaction effect of paternal dysregulation × toddler RSA, simple slopes were estimated for the toddlers who had low resting RSA (−1 *SD* below the mean), moderate resting RSA (the mean), and high resting RSA (+1 *SD* above the mean) (Aiken & West, 1991).

Among toddlers with high (b = -.02, SE = .01, p = .004, 95% CI = -.03 to -.01) and moderate (b = -.01, SE = .004, p = .006, 95% CI = -.02 to -.003) RSA, lower paternal dysregulation was associated with better toddler emotion regulation. There was no significant association between paternal dysregulation and toddler emotion regulation among toddlers with low resting RSA, b = -.003, SE = .01, p = .577, 95% CI = -.01 to .01, see Figure 3a.

Model A2 Independent variable: paternal dysregulation; moderator: toddler RSA reactivity. The overall model was significant, $F(6,85) = 3.46$, $p = .004$, $R^2 = .20$, however, a moderation effect was not supported, *b* = -.01, *SE* = .004, *p* = .103, 95% *CI* = -.02 to .002. In regard to main effects, paternal dysregulation (*b* = -.01, *SE* = .004, *p* = .015, 95% *CI* = -.02 to -.002) and maternal depression (*b* = -.10, *SE* = .03, *p* = .002, 95% *CI* = -.15 to -.03) each significantly, negatively predicted toddler emotion regulation.

Model B1 Independent variable: paternal engagement following a stressful task; moderator: resting toddler RSA. The overall model was significant, *F*(6,85) = 7.70, *p* = .000, R^2 = .35. Toddler RSA significantly moderated the association between paternal responsivity following a stressor and toddler emotion regulation (*b* =.01, *se* = .01, 95% *CI* = .003 to .03) as indicated by the confidence interval excluding a 0.

Post-hoc probing of the interaction effect revealed that among toddlers with high (*b* = .03, *SE* = .01, *p* = .000, 95% *CI* = .02 to .05) and moderate (*b* = .02, *SE* = .01, *p* = .001, 95% *CI* = .01 to .03) levels of baseline RSA, greater paternal engagement following a stressor was associated with better toddler emotion regulation. There was no significant association between paternal engagement and toddler emotion regulation among toddlers with low levels of RSA, *b* = .01, *SE* = .01, *p* = .367, see Figure 3b.

Model B2 Independent variable: paternal engagement following a stressful task; moderator: toddler RSA reactivity. The overall model was significant, *F*(6,85) = 4.42, *p* = .000, R^2 = .24; a moderation effect was not supported, *b* = .01, *SE* = .01, *p* = .396, 95% *CI* = -.008 to .02. In regard to main effects, paternal engagement (*b* = .02, *SE* = .01, *p* = .007, 95% *CI* = .005 to .03) and maternal depression (*b* = -.15, *SE* = .03, *p* = .000, 95% *CI* = -.21 to -.09) each significantly predicted toddler emotion regulation.

Model C1 Independent variable: paternal responsiveness during play; moderator: resting toddler RSA. The overall model was significant, *F*(6,85) = 2.42, *p* = .033, R^2 = .15, however, a moderation effect was not supported, *b* = -.05, *SE* = .07, *p* = .422, 95% *CI* = -.19 to .08. In regard to main effects, paternal responsiveness did not predict toddler emotion regulation (*b* = -.02, *SE* = .05, *p* = .654, 95% *CI* = -.13 to .08). Toddler RSA was the only variable that significantly, positively predicted toddler emotion regulation, such that higher levels of RSA predicted higher emotion regulation, *b* = .28, *SE* = .12, *p* = .017, 95% *CI* = .05 to .51.

Model C2 Independent variable: paternal responsiveness during play; moderator: toddler RSA reactivity. The overall regression model was not significant, $F(6,85) = 1.19$, $p = .317$, $R^2 = .08$. See Table 8 for summary of all regression analyses evaluating toddler resting RSA as a moderator (Models A1, B1, C1); see Table 9 for a summary of regression analyses evaluating toddler RSA reactivity as a moderator (Models A2, B2, C2).

Due to the purported uniqueness of father play on toddler socioemotional development, it was hypothesized that models including paternal responsivity during play (Models C1 and C2) as the independent variable would have larger effect sizes as compared to models that include paternal engagement following a stressor (Models B1 and B2). Because paternal responsivity during play was not a significant predictor of toddler emotion regulation in Model C1 or Model C2, it can be concluded that this hypothesis was not supported; paternal responsivity during play in this study was not more meaningful for child emotion regulation than paternal engagement following a stressor.

Aim 4: Paternal RSA and Key Study Variables

The final exploratory objective of the study examined if paternal RSA would be related to key study variables; each partial correlation controlled for demographic risk. Results revealed that paternal RSA was significantly related to paternal engagement following a stressor $r(88) = .23$, $p = .03$ and paternal responsivity during play $r(88) = .30$, $p = .005$. These results show that fathers with higher resting RSA, suggesting improved regulation, were more engaged during both high stress and low stress parenting contexts. Paternal RSA was not significantly related to toddler resting RSA $r(88) = .05$, $p = .631$, toddler RSA reactivity $r(88) = .04$, $p = .683$, toddler emotion regulation $r(88) = -.13$, $p = .227$, nor paternal emotion dysregulation $r(88) = .02$, $p = .866$.

CHAPTER 4: DISCUSSION

The purpose of the current study was to examine the intergenerational transmission of emotion regulation from fathers to their young children, among families in poverty. Findings demonstrate a robust association between dimensions of fathering and toddler emotion regulation. Paternal emotion regulation and engagement following a stressor predicted better toddler emotion regulation. This model explained 33% of the variance in the dependent variable. Further, resting respiratory sinus arrhythmia (RSA) moderated the associations between fathering and emotion regulation, such that toddlers with moderate and elevated levels of resting RSA benefitted from paternal emotion regulation and parenting engagement following a stressor. Fathers' responsivity during play did not have a direct or indirect effect on toddler emotion regulation. Together, results from this study emphasize the importance of fathering on toddler emotion regulation, and present important findings related to the roles of both caregiving and physiologic contexts in early regulatory development.

Toddler Emotion Regulation

During the first few years of life, meaningful developments in children's emotion regulation occur. Toddlers' regulation repertoire becomes increasingly sophisticated, as their coping behaviors diversify and strengthen. Failing to develop age-appropriate regulation competencies undermines socioemotional and behavioral functioning in childhood and adulthood (Beuachaine, 2015; Hayes et al., 1996). The first aim of this study was to descriptively report on toddlers' use of emotion regulation strategies in this sample of low-income and primarily African American children. Findings were that children employed a range of dyadic and individual emotion regulation strategies. Over the course of a 4.5-minute frustrating episode, all toddlers attempted at least three types of emotion regulation behaviors; most toddlers (95%) engaged in at least four different types of emotion regulation strategies. The most commonly used strategies were: interacting with the task object, social referencing, other forms of self-distraction, and attentional bids.

A similar study, conducted by Diener and Mangelsdorf (1999), examined emotion regulation behaviors during a frustrating laboratory task in a sample of 18-month to 24-month old children. As compared to the present study, the Diener and Mangelsdorf (1999) sample was low risk; most mothers were married, worked full-time, and had a four-year college degree. Several indices of emotion regulation were consistent across both studies, and were able to be compared. Toddlers' average number of emotion regulation behaviors are presented as follows: (*current study mean* vs *Diener & Mangelsdorf, 1999 mean*). Cross-study emotion regulation codes were: social referencing (16.83 vs 14.19); distraction (11.21 vs 9.27); and attention bid (4.80 vs 3.88). Children's use of these emotion regulation strategies was generally comparable across both studies. Although less than 1 standard deviation separates each set of scores, toddlers in the current study had slightly higher average scores. This may be due differing frustration tasks employed in each study or that toddlers in the current study were a few months older than the Diener and Mangelsdorf (1999) sample.

Together, descriptive inventory of toddlers' emotion regulation strategies in this study suggest that these children engage in a range of strategies while experiencing stress. As expected, dyadic processes (social referencing and attention bids) are commonly used regulation strategies in toddlerhood (Kopp, 1989). Simultaneously, increasingly self-initiated and independent strategies are also attempted, such as interacting with the desired object and counting fingers. When juxtaposing several indices of toddlers' emotion regulation with another, lower risk sample (Diener & Mangelsdorf, 1999), toddlers' average use of three types of strategies was approximately commensurate across samples. Contrary to expectation, this may provide some preliminary indication that children in the current sample are performing these behaviors similarly to low-risk peers. More rigorous research directly comparing toddlers from differing socioeconomic backgrounds using the same methodology would be needed to draw more confident conclusions about the nature of these similarities and differences.

Fathering and Toddler Emotion Regulation

When considering the etiology of adaptive emotion regulation, we know that caregivers play a meaningful role through processes such as modeling and parenting practices (Morris et al., 2007). Much of this literature has focused on maternal contributions to child emotion regulation. When fathering has been studied, the goal has often been to quantify low-income fathers' involvement in their children's lives (Coles & Green, 2010). An almost exclusive focus on mothering and a lack of literature on the *quality* of fathering interactions reflect significant limitations in the field.

Emerging evidence underscores low-income and ethnic-minority fathers' role in promoting socioemotional development through practices such as supportive caregiving and play (Cabrera et al., 2007; Cabrera, Fitzgerald, Bradley, & Roggman, 2014). The second aim of this study sought to add to this body of research by examining how differing dimensions of fathering (paternal emotion dysregulation, engagement following a stressor, responsivity during play) would relatively relate to toddler emotion regulation. This study hypothesis was partially confirmed, as father dysregulation predicted poorer toddler emotion regulation, and paternal engagement following a stressor predicted better emotion regulation. These results join a growing literature that highlights the importance of father wellbeing and supportive interactions in promoting vulnerable children's early socioemotional development. These findings are particularly robust given that maternal depression, a long-established salient risk for child socioemotional outcomes, was controlled for in the current analyses.

Among fathering practices in general, play has been proposed as a uniquely influential practice through which fathers socialize young children's emotion regulation (Bocknek et al., 2017; Dumont & Paquette, 2013). The *activation relationship hypothesis* posits that fathers provide young children with exposure to emotionally arousing play, which is then paired with the practice of regulating this arousal through dyadic interactions (Paquette, 2004; Roggman et al., 2004). Consistent with this theory (Paquette, 2004), the current study hypothesized that fathering during play, as compared to other indices of fathering, would have the greatest effect size in predicting toddler emotion regulation. Contrary to expectation, there was no direct or indirect effect of paternal play on toddler emotion regulation.

There are several possible interpretations to contextualize the null finding of father play. First, it is possible that the null finding can be attributed to methodological differences. The play activation hypothesis studies generally utilize a very arousing play task; for example, one such task reaches its peak arousal as fathers are instructed to encourage the child to ascend a small flight of stairs (Paquette & Dumont, 2013). The current study inventoried fathering during play by asking father-toddler dyads to play with a series of three toys—a bean bag toss game, a puzzle, and medical kit. Thus, it is possible that this play task was not stimulating enough to be consistent with the proposed play-activation theory.

On the other hand, it is possible that during toddlerhood, paternal regulation and responsiveness during stress are more meaningful for emotion regulation than are play relationships. In support of this conceptualization, Cabrera et al. (2007) found that supportive fathering was uniquely important for toddlers' emotion regulation at the age of 2, but not at 4 years of age. Further, some argue that mothers and fathers parent more similarly than differently, and the long-established optimal parenting practices of mothers, such as emotional wellbeing and sensitivity during stress, also apply to optimal fathering (Fagan et al., 2014). Clarity on this topic could be achieved by comparing the relative importance of differing contexts of fathering on toddler outcomes, and including a measure of play that is methodologically consistent with the activation play hypothesis.

Toddler RSA and Associations with Fathering and Emotion Regulation

A growing literature highlights the necessity of studying dynamic interrelations between environment and physiology, and between caregiver and child. The differential susceptibility hypothesis suggests that some individuals are more susceptible than others to both positive and negative aspects of environmental influence (Belsky & Pluess, 2009). Results from this study partially support a differential susceptibility model, such that toddlers with elevated and moderate levels of resting RSA were likely to have better emotion regulation as the caregiving environment became more supportive (i.e. better regulated fathers; more engaged fathers following a stressor). However, the latter part of the theory was not supported in this study: toddlers with low resting RSA were not more reactive to less optimal fathering (i.e. worse regulated fathers; less engaged fathers following a stressor). In other words, toddlers with elevated resting RSA were more influenced by fathering than toddlers with low RSA, but only in supportive fathering contexts. Whereas toddlers with low RSA engaged in fewer emotion regulation behaviors, irrespective of fathering quality.

At rest, elevated RSA indicates that the parasympathetic nervous system is promoting a calm, more regulated physiologic state. There is a large literature to suggest that elevated resting

RSA is associated with better coping during early childhood (Eisenberg et al., 2012), and generally positive outcomes across the lifespan (Beauchaine, 2015; Kidwell & Barnett, 2007). In this study, the positive effects of elevated resting RSA may help children to fully attend to their immediate environment, thereby increasing their ability to benefit from their fathers' regulation and supportive caregiving.

Conversely, low RSA at rest is viewed as a marker of stress vulnerability. Multiple studies have documented low resting RSA is a risk for poor psychological outcomes, including internalizing and externalizing problems (Beauchaine et al., 2007; Shannon et al., 2007; Skowron et al., 2014). However, in the current study, there was not a significant effect for toddlers with low resting RSA. Thus, toddlers with low resting RSA in this sample were not negatively impacted by poor parenting or positively impacted by supportive parenting. This finding may provide evidence that parasympathetic reactivity only influences young children's emerging emotion regulation competencies in certain contexts.

Further, no significant main effects or interaction effects were found for toddlers' RSA suppression or augmentation in this study. Suppressed, or decreasing RSA responses from rest to a stressor are thought to reflect one's capacity for regulation in that context. In line with this theory, multiple studies have documented that moderate-high suppression relates to socioemotional competence, whereas low suppression is a risk for poor emotion regulation and other maladaptive outcomes (Graziano et al., 2007; Katz et al., 2007). However, some researchers have also failed to find expected associations among RSA suppression and child outcomes (e.g. Eisenberg et al., 2012; Keller, Kouros, Erath, Dahl, & El-Sheikh, 2014; Morales, Beekman, Blandon, Stifter, & Buss, 2015; Skowron et al., 2011). In order to account for these inconsistencies, it has been theorized that repeated exposure to stressors and repeated activation of physiological stress responses may lead to “wear and tear” on the parasympathetic nervous system, thus decreasing resting RSA and lessening RSA reactivity responses (Moore, 2010; Porter, Wouden-Miller, Silva, & Porter, 2003; Propper & Moore, 2006; Whitson & El-Sheikh, 2003).

Another possible explanation for the null RSA suppression/augmentation finding is that the relative importance of the suppression effect may depend on who the child is interacting with. Mothers continue to provide the majority of child care for young children (Craig, 2006; Sanie et al., 2016), thus, it is possible that significant suppression or augmentation effects could exist within the context of the mothering in this sample of children, even if they are not present within the context of fathering (Cooper-Vince et al., 2017).

Paternal RSA and Associations with Fathering and Child Factors

The above reported findings from this study suggest a path where certain contexts of fathering differentially promote children’s emotion regulation, as a function of toddlers’ resting RSA. A necessary step in understanding this intergenerational process is to also obtain information regarding the role of paternal psychophysiology. In this study, exploratory analyses were conducted to examine whether paternal resting RSA influenced key father and child constructs. It is noteworthy that paternal resting RSA was positively associated with parenting in both contexts: following a stressor and during play. Fathers who had higher resting RSA (a marker of regulation) were more engaged and responsive during these tasks. There were no other significant associations between fathering and father dysregulation or other child variables, such as child RSA. The latter null finding was expected given findings from previous studies (e.g., Bornstein & Suess, 2000; Perlman et al., 2008).

Associations between paternal resting RSA and parenting are consistent with Porges’ theory (1995); elevated resting RSA diminishes one’s individual emotional reactivity, thereby improving their attention to environmental demands (Porges, 1995). Therefore, fathers in this study who had better parasympathetic regulation were more able to focus their attention on their children following a stressor and during play. Although there are very few studies examining paternal RSA and parenting of toddlers (Blandon, 2015; Perlman, Camras, & Pelphrey, 2008), this finding is supported by the mothering literature (Mills-Koonce et al., 2007; Moore et al., 2009).

Limitations

Though study results are generally robust there are several limitations to consider. First, the present sample is reflective of socioeconomically disadvantaged and primarily African American families. Results presented in this manuscript may not generalize across families of differing backgrounds. Further, and as reported, there were missing data in this study. To address this limitation, best practices were used to reduce the effect of missingness, including conducting missing value analysis and performing the most appropriate imputation to estimate missing data, multiple imputation (Graham, 2009). A strength of this study was assessing constructs at multiple levels of analysis, including observed and physiological measures. Only one primary study independent variable was not observed: paternal emotion dysregulation was obtained via self-report. Self-report can be sensitive to response bias; an observed measure of fathers' regulation may have allowed for more ecologically valid conclusions.

Further, results related to paternal RSA were promising; however, based on the relatively smaller sample size, there was not sufficient power to add this measure to primary moderated regression models. Future research would benefit from examining effects of paternal RSA on these associations in more complex models. Finally, data collected in this study were cross-sectional, meaning that it is not possible to draw causal inferences regarding directionality of effects. To address causality, it would be beneficial to replicate these models in a longitudinal study.

Implications for Research

There are several strengths of this study that add to existing literature, and also suggest pathways for future study. A strength of this study was that toddler emotion regulation was assessed by coding toddlers' use of regulation strategies during a frustrating laboratory task. This is a preferred method as compared to both parent-report measures and observed emotion distress measures (Cole et al., 2004). To advance the study of emotion regulation, some scholars argue that the effectiveness of these strategies needs to be examined using dynamical systems modeling. Dynamical systems modeling uses time series data to explore the interplay of child regulation strategies and emotional responses (Cole et al., 2017). Importantly, this type of design would allow researchers to go beyond summing regulation strategies, to conclude if engaging in a given regulation behavior would have an immediate effect on toddlers' level of distress.

Another key strength of this study was that it focused on an understudied sample of low-income and primarily African American fathers and their toddlers. In addition, fathering was captured in multiple contexts, including father's own emotion dysregulation, fathering during stress, and fathering during play. Although maternal depression was controlled for these studies, it will be important for future research to expand these models to examine fathering within the broader family context, including triadic family processes. In regard to parasympathetic arousal, this study measured toddler and father resting RSA and toddler RSA reactivity from baseline to a stressor. However, studies are pointing to the importance of differential modeling of RSA such as linear and quadratic effects of RSA across different tasks and different developmental stages (Cui et al., 2015). Further, in addition to resting RSA and RSA reactivity, some suggest that individual differences in RSA *recovery* from a stressor back to rest may also reflect a key process in regulation (Sanders, 2017). Thus, future research would benefit from comparing models of RSA to identify those that are most appropriate and informative for the study of emotion regulation.

Implications for Practice

Results from this study inform our approach to prevention and intervention programs that are designed to support young children's emotion regulation. First, findings demonstrate that paternal emotion regulation matters, not just for fathers' own wellbeing, but because of the effect that it has on his children. Several existing interventions address maternal psychopathology within the context of parenting. This study suggests that these programs should be expanded to address paternal wellbeing, particularly as it relates to fathers' ability to regulate his emotional experiences. Such an approach to intervention may be particularly relevant for low-income families, who are at increased risk for exposure to poverty-related stressors that undermine child and caregiver wellbeing (Kim et al., 2013; Raver, 2004). In addition, this study joins a growing literature emphasizing that fathering *quality* is meaningful for early child development. Thus, it is likely important to involve fathers in parenting interventions, such as psychoeducational parent training programs, or perhaps hands-on interventions (e.g. Parent Child Interaction Therapy-PCIT), even when fathers do not share a primary residence with their children.

Conclusions

This study intended to shed light on fathers' role in socializing young children's emotion regulation, among families living in poverty. Father's own emotional wellbeing, as well as his supportive interactions with his child following a stressor emerged as significant aspects of the caregiving environment. Further, physiologic influence on these associations was addressed by assessing both toddler and father respiratory sinus arrhythmia. To the best of our knowledge, this is the first study to report on the moderating effects of toddler parasympathetic functioning on the association between fathering and toddler emotion regulation. Partial support was obtained for a differential susceptibility hypothesis, where toddlers' RSA moderated their sensitivity to fathering, such that toddlers with better indicators of resting physiological functioning engaged in more optimal emotion regulation as the caregiving environment became more supportive. Further, fathers' own RSA related to his parenting across stress and play contexts. Together, results support the intergenerational transmission of emotion regulation through fathering, and emphasize both fathers' role and children's individual physiology in supporting resilient developmental trajectories for young children facing poverty-related conditions of risk.

APPENDIX A

Table 1.
Sample Demographic Information

	Fathers		Mothers	
	Mean (SD)	Range	Mean (SD)	Range
Toddler Age (months)	29.64 (3.10)	24-31		
Parent Age	31.15 (8.05)	20-52	27.93 (5.73)	19-46
Number of Children	3.45 (2.48)	1-13	2.98 (1.91)	1-12
	n	%	n	%
Toddler Gender				
Girls	36	39.13%		
Boys	56	60.87%		
Paternal Residence				
Lives with Child	63	79.80%		
Does not Live with Child	29	20.92%		
Parent Ethnicity				
African American	83	90.20%	81	88%
European American	3	3.30%	3	3.30%
Hispanic/Latino	2	2.20%	2	2.20%
Asian	1	1.10%	1	1.10%
Multicultural	3	3.30%	5	5.40%
Parent Education				
Some High School	16	17.39%	13	14.10%
High School Graduate	42	45.65%	29	31.50%
Some College	31	33.69%	40	43.48%
Associate or Bachelor’s degree	3	3.26%	10	10.87%
Parent Relationship Status				
Single	12	13.04%	16	17.39%
Partnered	80	86.96%	76	82.60%
Yearly Income				
Less than $5,000	26	28.26%	17	18.48%
$5,000 - $15,000	36	39.13%	33	35.87%
$15,000 - $30,000	20	21.74%	27	29.35%
More than $30,000	10	10.87%	15	16.30%

Table 2.
Bivariate Associations Among Primary Study Variables

Variable	1	2	3	4	5	6	7	8	9
1. Toddler Emotion Regulation	-								
2. Toddler Resting RSA	.25*	-							
3. Toddler RSA Reactivity	-.07	.02	-						
4. Father Dysregulation	-.24*	-.21*	-.13	-					
5. Father Engagement-Stress	.10	-.10	.17	-.09	-				
6. Father Responsivity-Play	-.08	-.09	-.02	.02	.10	-			
7. Toddler Baseline State	-.18*	.14	.18	-.12	.04	-.01	-		
8. Maternal Depression	-.35**	-.13	.10	-.06	.32*	.19	.23*	-	
9. Demo Risk	.04	-.12	.11	.00	-.06	-.25*	-.01	-.08	-
Mean	0	4.74	0	74.34	6.90	10.79	2.85	6.33	1.56
Std. Deviation	1	.91	1	24.01	1.72	1.95	.76	3.51	1.01

Note: Toddler Baseline refers to toddler level of distress directly preceding emotion regulation task; Toddler Emotion Regulation is a standardized variable; Toddler RSA Reactivity is a standardized variable; τp < .10, *p < .05, ** p < .01

Table 3.
Independent-samples T Tests Evaluating Toddler Gender as a Covariate

	Toddler Gender					
	Female		Male			
Test Variable	M	SD	M	SD	t	p
Toddler Emotion Regulation	.16	1.07	-.08	1.00	-1.10	.274
Toddler Resting RSA	4.88	.85	4.66	.94	-1.15	.253
Toddler RSA Reactivity	.04	1.04	-.04	.97	-.34	.734
Paternal Dysregulation	74.94	26.73	73.96	22.33	-1.19	.849
Paternal Engagement-Stress	7.25	16.84	8.27	20.26	.25	.802
Paternal Responsivity-Play	10.59	2.24	10.98	2.50	.75	.445

Table 4.
Independent-samples T Tests Emotion Regulation: a) Toy Behind Barrier and b) Child Had Toy

	Toy Behind The Barrier Task					
	a) Toy Behind Barrier		b) Child Had Toy			
Test Variable	M	SD	M	SD	t	p
Attention Bid	4.93	4.99	.32	.64	8.77	.000
Social Referencing	16.42	6.98	2.88	2.13	17.81	.000
Distraction	11.33	8.21	.35	1.12	12.70	.000
Physical Action	2.91	4.21	.09	.39	6.40	.000
Interact with Object	17.21	7.27	11.63	2.33	7.00	.000
Cognitive Reappraisal	.13	.91	.04	.24	.88	.380

Table 5.
Bivariate Associations among Emotion Regulation Coded Behind the Barrier

Variable	1	2	3	4	5	6
1. Attention Bid	-					
2. Social Referencing	.45**	-				
3. Distraction	-.004	.37**	-			
4. Physical Action	.11	.20	-.29*	-		
5. Interact with Object	.27τ	.17	-.15	.18	-	
6. Cognitive Reappraisal	.32τ	.07	.11	-.09	.03	-

Note: τp < .10, *p < .05, ** p < .01

Table 6.
Toddler Emotion Regulation Scale Factor Loadings

	Factor Loadings		
Items	1	2	3
Attention Bid	.34	.32	.78
Social Referencing	.87	-.13	
Distraction	.60	-.78	
Physical Action		.41	
Interact with Object		.30	
Cognitive Reappraisal			.45

Note: common factor analysis (principle axis analysis) with varimax rotation.

Table 7.
Hierarchical Regression Analyses Evaluating Fathering as a Predictor of Toddler Emotion Regulation

	Toddler Emotion Regulation			
Predictor	B	SE B	p	ΔR^2
Step 1				.20**
Demo Risk	-.01	.09	.947	
Toddler Baseline State	-.15	.13	.280	
Maternal Depression	-.14	.03	.000	
Toddler Resting RSA	.22	.11	.055	
Step 2				.13**
Paternal Dysregulation	-.01	.004	.030	
Paternal Engagement-Stress	.02	.01	.003	
Paternal Responsivity-Play	-.01	.05	.831	
Total R^2	-	-	-	0.33**

Note: beta weights for each predictor reflect the final weights after all predictors were entered. ΔR2 reflects increments in variance for each block after that particular block was entered. *p < .05, ** p < .01

Table 8.
Summary of Hierarchical Regression Analyses Predicting Toddler Emotion Regulation, Resting RSA Moderates

		B	SE B	p	LLCI	ULCI	ΔR^2
Model A1	Step 1						.22**
	Demo Risk	-.001	.09	.983	-.17	.17	
	Toddler Baseline State	-.18	.13	.164	-.43	.07	
	Maternal Depression	-.08	.03	.004	-.14	.03	
	Paternal Dysregulation	-.01	.004	.006	-.02	-.003	
	Toddler Resting RSA	.23	.11	.033	.02	.44	
	Step 2						.04*
	Paternal Dysregulation x Toddler Resting RSA	-.01	.01	.044	-.02	-.001	
Model B1	Step 1						.31**
	Demo Risk	.04	.09	.704	-.15	.22	
	Toddler Baseline State	-.18	.13	.158	-.43	.07	
	Maternal Depression	-.14	.03	.000	-.19	-.08	
	Paternal Engagement-Stress	.02	.01	.001	.01	.03	
	Toddler Resting RSA	.24	.11	.028	.03	.44	
	Step 2						.05*
	Paternal Engagement-Stress x Toddler Resting RSA	.01	.01	.016	.003	.03	

Model C1		Step 1					.14*
	Demo Risk	.06	.10	.577	-.15	.26	
	Toddler Baseline State	-.14	.14	.311	-.41	.13	
	Maternal Depression	-.06	.03	.066	-.12	.003	
	Paternal Responsivity-Play	-.02	.05	.654	-.13	.08	
	Toddler Resting RSA	.28	.12	.017	.05	.51	
		Step 2					.01
	Paternal Responsivity-Play x Toddler Resting RSA	-.05	.07	.422	-.19	.08	

Note: beta weights for each predictor reflect the final weights after all predictors were entered. LLCI = lower limit confidence interval. ULCI = upper limit confidence interval. ΔR2 reflects increments in variance for each block after that particular block was entered. *p < .05, ** p < .01

Table 9.
Summary of Hierarchical Regression Analyses Predicting Toddler Emotion Regulation, RSA Reactivity Moderates

		B	SE B	p	LLCI	ULCI	ΔR^2
Model A2	Step 1						.17*
	Demo Risk	-.07	.10	.507	-.27	.13	
	Toddler Baseline State	.05	.13	.704	-.21	.31	
	Maternal Depression	-.09	.03	.002	-.15	-.03	
	Paternal Dysregulation	-.01	.004	.015	-.02	-.002	
	Toddler RSA Reactivity	-.07	.10	.503	-.28	.14	
	Step 2						.03
	Paternal Dysregulation x Toddler RSA Reactivity	-.01	.004	.103	-.02	.002	
Model B2	Step 1						.23**
	Demo Risk	-.001	.10	.993	-.19	.19	
	Toddler Baseline State	-.03	.13	.834	-.29	.23	
	Maternal Depression	-.15	.03	.000	-.21	-.09	
	Paternal Engagement-Stress	.017	.01	.007	.02	.03	
	Toddler RSA Reactivity	-.01	.10	.925	-.21	.19	
	Step 2						.01
	Paternal Engagement-Stress x Toddler RSA Reactivity	.01	.01	.396	-.01	.02	

Model C2	Step 1						.05
	Demo Risk	-.08	.10	.437	-.28	.12	
	Toddler Baseline State	-.14	.14	.339	-.41	.14	
	Maternal Depression	-.06	.03	.066	-.12	.004	
	Paternal Responsivity-Play	-.03	.06	.663	-.15	.09	
	Toddler RSA Reactivity	-.01	.10	.930	-.22	1.75	
	Step 2						.03
	Paternal Responsivity-Play x Toddler RSA Reactivity	.11	.07	.105	-.02	.25	

Note: beta weights for each predictor reflect the final weights after all predictors were entered. LLCI = lower limit confidence interval. ULCI = upper limit confidence interval. ΔR2 reflects increments in variance for each block after that particular block was entered. *p < .05, ** p < .01

Figure 1.
Depiction of Primary Study Moderation Models, Hypotheses 3a-3c

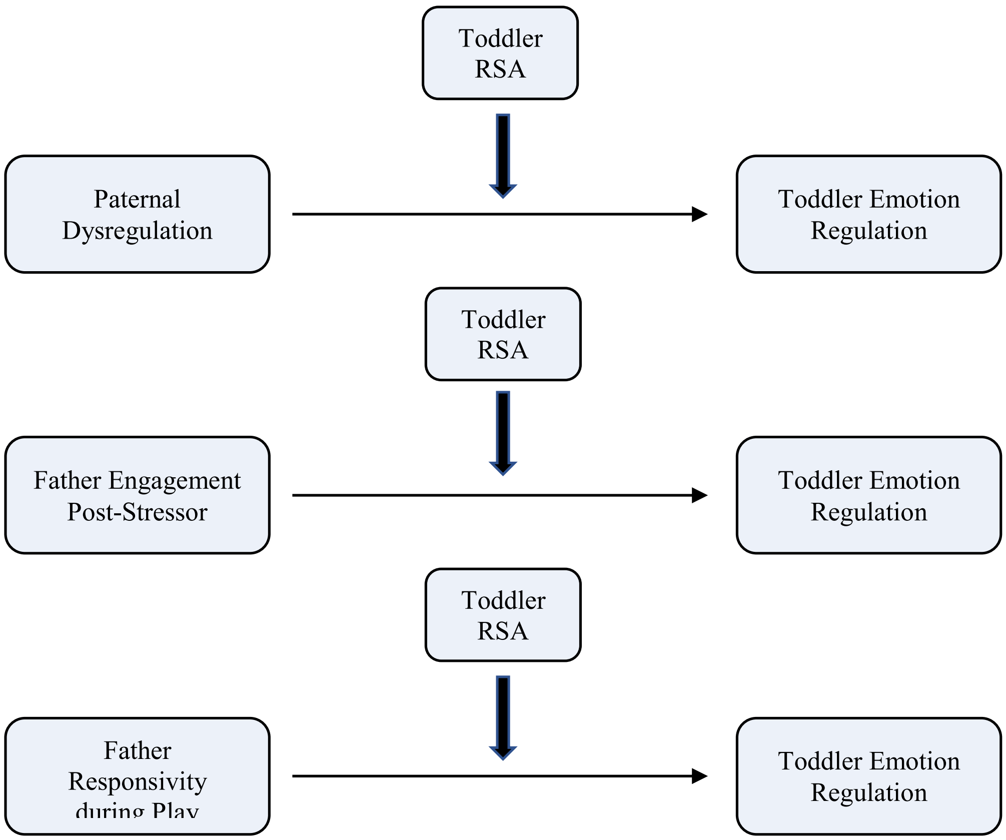
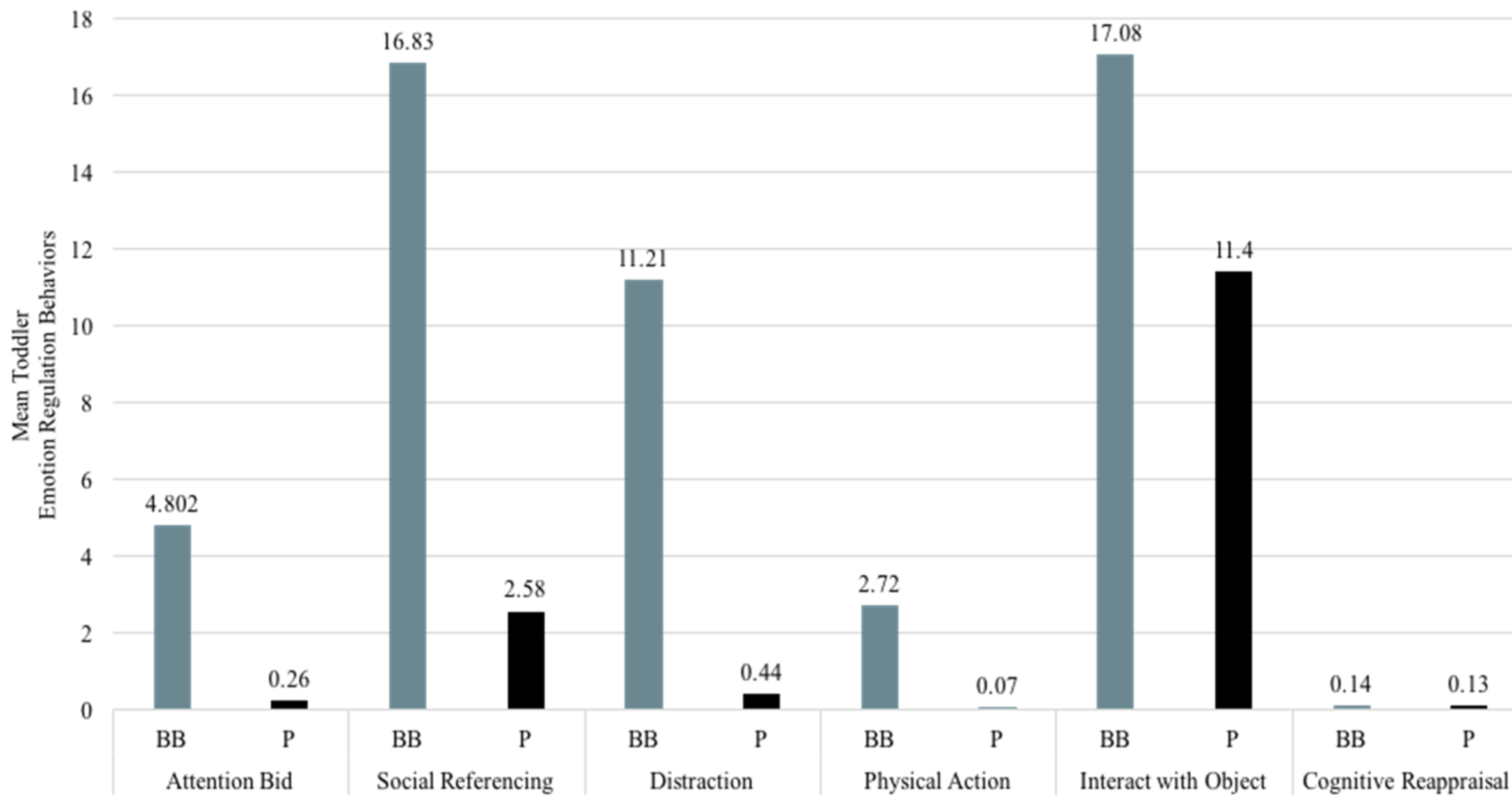


Figure 2.
Average Toddler Emotion Regulation Behaviors



Note: BB = toy behind the barrier; P = child had toy

Figure 3a.

Relationship Between Paternal Emotion Dysregulation and Toddler Emotion Regulation, Moderated by Toddler Resting RSA

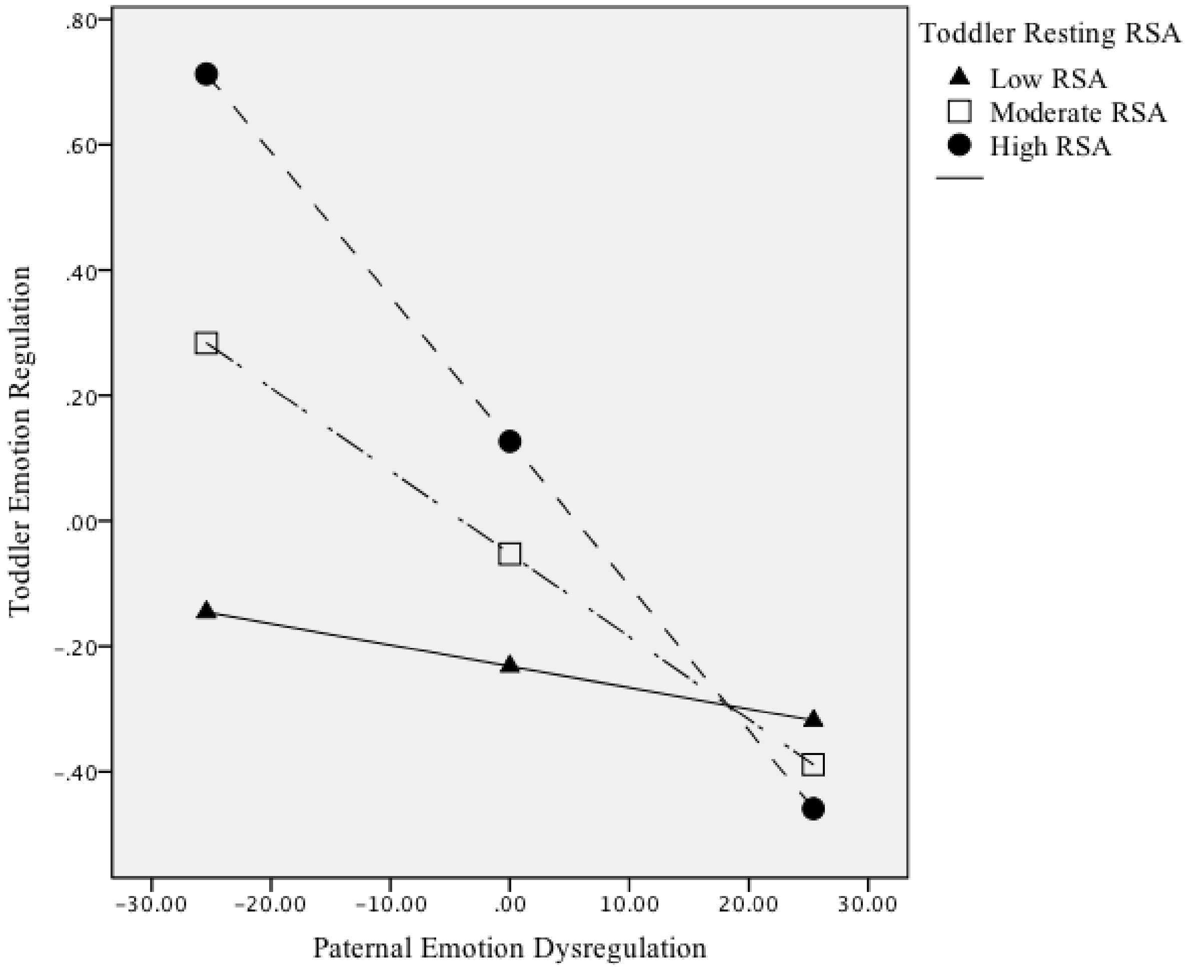
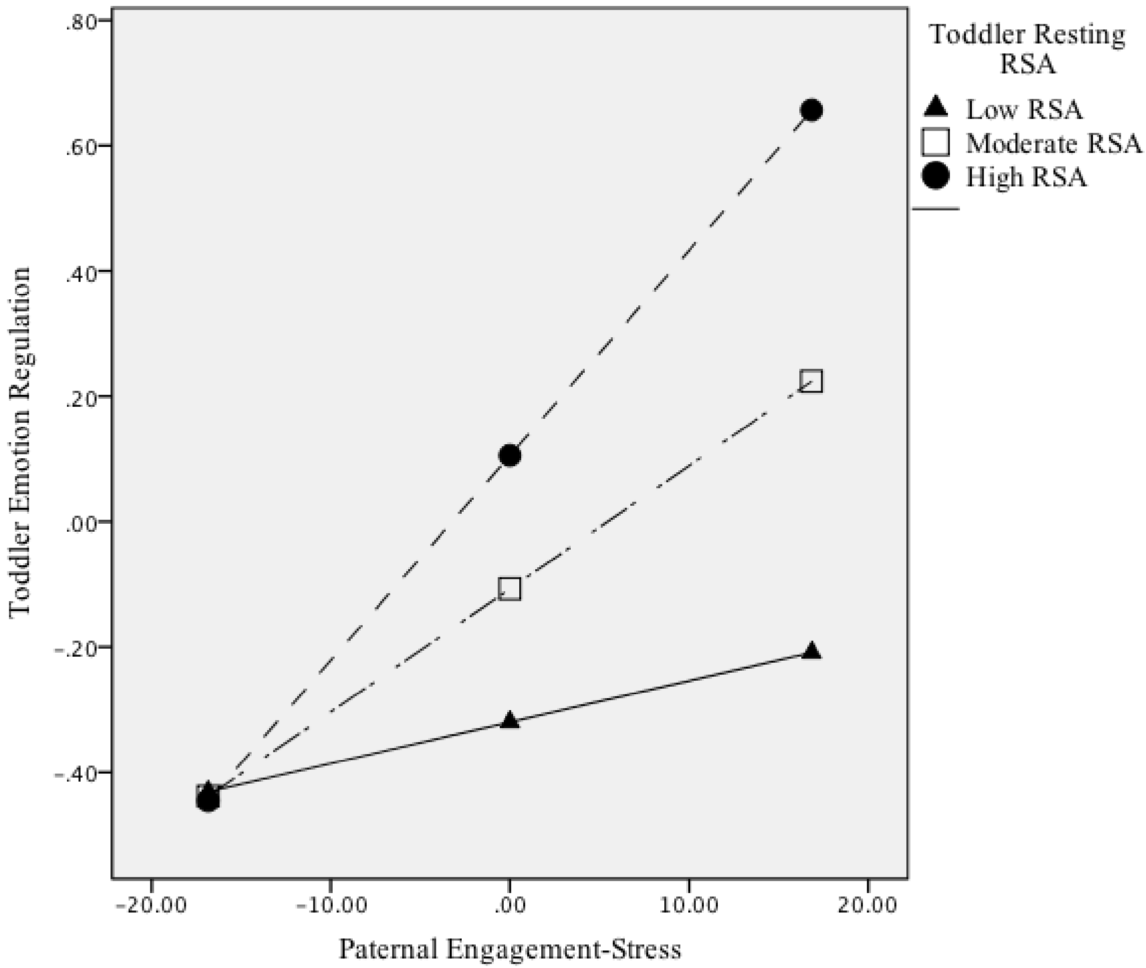


Figure 3b.
Relationship Between Paternal Engagement Following a Stressor and Toddler Emotion Regulation, Moderated by Toddler Resting RSA



APPENDIX B

Demographic Information

1. Are you one of the primary caregivers for your child? That is, do you have or share legal custody of him/her? Or does your child currently live with you at least half of the time?
   ○ Yes ○ No ○ Don't Know ○ Refused to Answer
2. What is your relationship to your child?
   ○ Biological Mother ○ Stepmother ○ Adoptive Mother
   ○ Grandmother ○ Biological Father ○ Stepfather
   ○ Adoptive Father ○ Mother's Romantic Partner ○ Grandfather
   ○ Other, Specify________________________
3. What is your age? ___________ years
4. Race:

Your Ethnoracial Status	Your Child's Ethnoracial Status
□African American	□African American
□American Indian	□American Indian
□Asian (specify country:___________)	□Asian (specify country:_________)
□Caucasian, not hispanic	□Caucasian, not hispanic
□Pacific islander	□Pacific islander
□ Arab (Muslim)	□Arab (Muslim)
□ Chaldean	□Chaldean
□ Hispanic/Latino	□ Hispanic/Latino
□Unknown race	□Unknown race
□Other:________________________	

5. The country that you were born in:______________________________
6. Generation status:

Your Generation Status	Your Child's Generation Status
□Immigrant	□Immigrant
□Born in America	□Born in America
□Second generation	□Second generation
□Third generation	□Third generation
□4th generation and higher	□4th generation and higher

7. The languages you speak at home with your children:_____________________
8. How many children do you have? _______________
9. Please provide a COMPLETE list of all people over the age of 21 living in your home according to their relationship to you (*example:* my mother, my grandfather, my boyfriend, my friend)____
10. Please provide a COMPLETE list of all children/youth under the age of 21 living in your home according to their relationship to you; also, please provide their ages (*example:* my 2-year-old daughter, the 12-year-old son of my boyfriend, my 8-year-old niece, my 3-year-old foster child, my 13-year-old adopted daughter, my 20-year-old brother).
    ____
11. Please provide a COMPLETE list of all people who provide social support (such as babysitting or running errands) to you who do not live in your home according to their relationship to (*example:* my neighbor, my boyfriend, my mother, people at my church)
    ____
12. What is your work status? FILL IN ALL THAT APPLY
    ○ Full time ○ Part-time ○ Not employed

○Disabled/ unable to work ○ Student

13. What was your total family income in the past 12 months (before taxes and deductions)?
$ _______ , ________
○ None ○ $1-$5,000 ○ $5001-$10,000 ○ $10,001-$15,000
○ $15,001-$20,000 ○ $20,001-$30,000 ○ More than $30,000

14. What is your marital status? FILL IN ALL THAT APPLY
○ Married ○ Divorced ○ Separated
○ Cohabiting/Unmarried ○ Engaged/Serious Relationship ○ Widower
○ Not in a Relationship Presently

15. What best describes your current housing?
○House you own (*Not to interviewer, "house" includes detached condominiums)
○House you rent
○Apartment or condo you own (*Not to interviewer, "apartment" includes attached condominiums)
○Apartment or condo you rent (*Not to interviewer, "apartment" includes attached condominiums)
○ Trailer or mobile home you own ○ Trailer or mobile home you own
○ Staying with family ○ Staying with friends

16. How long have you lived at current residence?_____years and ____months

17. Does child share a room? ○Yes ○No
If yes, with who?" (*Note to interviewer, probe for relationship and age if child (e.g., "6 yr old sister")________________________________

18. CHILD's biological father: ○ Lives with child full-time
○ Lives with child part-time (i.e. shared custody)
○ Doesn't live with child but has regular/consistent contact
○ Has inconsistent contact with child
○ Has no contact with child

19. Child has father figure who is not child's biological father:
○ No ○ Yes (what is his relationship to you or your child?)_______
If yes, this father figure: ○ Lives with child full-time
○ Lives with child part-time (i.e. shared custody)
○ Does not live with child but has regular and consistent contact
○ Has inconsistent contact with child
○ Has no contact with child

20. How many weeks along in pregnancy was your child born?
○ 37-40 weeks gestation ○ 35-36 weeks gestation ○ 30-34 weeks gestation
○ 24-29 weeks gestation ○ prior to 24 weeks gestation

21. Has your child been identified by a pediatrician or other health professional with a delay in development?
○ YES ○ NO ○ DON'T KNOW ○ Refused

22. Does the child have a medical diagnosis?
○ YES ○ NO ○ DON'T KNOW ○ Refused

23. Have you ever been separated from your child for more than 1 month (no in person contact)?

○ YES ○ NO ○ DON'T KNOW ○ Refused

If yes, for how long? ___________________For what reason?__________________

The Emotion Dysregulation Scale

Please rate the extent to which the following items describe you, where *1= not true at all*, *4= somewhat true*, and *7= very true*.

1) My emotions seem unpredictable, even to me.	1	2	3	4	5	6	7
2) It is often hard for me to calm down when I am upset.	1	2	3	4	5	6	7
3) My emotions seem to just come out of the blue.	1	2	3	4	5	6	7
4) When I am upset, I have trouble knowing exactly what I am feeling; I just feel bad.	1	2	3	4	5	6	7
5) When I am feeling bad, I have trouble remembering anything positive; everything just seems bad.	1	2	3	4	5	6	7
6) When I feel sad, I feel *really* sad.	1	2	3	4	5	6	7
7) Emotions overwhelm me.	1	2	3	4	5	6	7
8) When I am upset, I feel all alone in the world.	1	2	3	4	5	6	7
9) When I am upset, I have trouble seeing things from the other person's point of view.	1	2	3	4	5	6	7
10) When I am upset, I have trouble solving problems.	1	2	3	4	5	6	7
11) When I am upset, I have trouble remembering that people care about me.	1	2	3	4	5	6	7
12) When I'm upset, everything feels like a disaster or crisis.	1	2	3	4	5	6	7
13) My emotions can change suddenly, almost without warning.	1	2	3	4	5	6	7
14) When I'm upset I have trouble seeing or remembering anything good about myself.	1	2	3	4	5	6	7
15) Sometimes my emotions seem so strong that people might think I'm acting or exaggerating, but its how I really feel.	1	2	3	4	5	6	7
16) I have trouble soothing myself when I'm upset.	1	2	3	4	5	6	7
17) When I'm upset, I often need help from another person to calm me down.	1	2	3	4	5	6	7
18) When I'm anxious, I feel really anxious.	1	2	3	4	5	6	7
19) When my emotions are stirred up, I have trouble thinking clearly.	1	2	3	4	5	6	7
20) When I feel angry, I get really angry.	1	2	3	4	5	6	7
21) When my emotions are strong, I often make bad decisions.	1	2	3	4	5	6	7
22) My emotions sometimes spiral out of control.	1	2	3	4	5	6	7
23) I'm a person of extremes.	1	2	3	4	5	6	7
24) When I'm upset, I sometimes become needy or clingy.	1	2	3	4	5	6	7

RSA Coding Instructions

1. Find the video file for the given segment. Open it using VLC. Identify the start and stop time for the segment of interest and enter these times *<u>in seconds</u>* on the excel spreadsheet "HRV Dataset." How to determine start/stop times:
    a. Bubble Guppies Video
        i. Start: When the researcher has left room and door shut
        ii. Stop: As soon as the researcher has reentered the room
    b. Book Sharing
        i. Start: When the researcher has left the room and the door is closed
        ii. Stop: As soon as the researcher has reentered the room
    c. Separation (coding only the first separation)
        i. Start: When both parents have left room and the door is closed
        ii. Stop: When the parents open the door to reenter room
2. Open the file in HRV Analysis 3.1.1 Software (software key must be in computer for it to run)
    a. Select appropriate channels data:
        i. Bio → ECG
        ii. Bio_2 → Resp
        iii. GSC → EDA
        iv. X Axis → dZ/dt
    b. Most preset settings are fine. However, you will need to adjust start time and end time for each video file: Go to the <u>Events and Modes</u> tab. Enter the start/stop time for the video *in seconds*. Note "Segment Time" should be "60" (as in 1-minute segments).
3. Click Analyze (green button lower portion of screen)
4. You will now be able to edit r's (click edit r's button). Generally speaking, you will need to check for:
    a. Yellow R Peaks: If there is an incorrectly identified R peak, you will need to delete it. If it has not correctly identified an R peak, you will need to insert it.
    b. The final R Peak at the very end of the segment: If the R peak is not followed by a full t-wave (ie: if it's not the same length as the other t waves, as compared to other full segments), it needs to be deleted.
5. Click "Write Segment" and opt to open a new excel document.

6. Repeat the above steps until you have written data for each segment into the existing excel doc
    c. Note, depending on the length of the task, there could be anywhere from 2-5 segments of a video
7. When you have checked R peaks for all segments of a video, save the excel document with the data on the hard drive 1 in the "HRV Coding" folder in your coding folder.

Paternal Engagement-Stress

The bubbles task was videotaped and later coded by a team of three independent coders using the Family Reunion and Play Procedure Microcoding System; a coding system made specifically for this project by the lead coder (a post-doctoral fellow) and the study PI. Coders completed seven training videos together, and then were assigned 5 videos to code in order to establish reliability; reliability of these training videos was .76. Once training was complete, coders were assigned 3-4 videos per week; approximately 25% of videos were double coded to ensure reliability (for a total of 22 double-coded videos). The coding team met regularly as assignments were complete and discussed discrepancies in the coding. Mangold Interact Software was used for all coding and determining Interrater reliability for all codes; final reliability was K = .62 (range from .39-.95; NOTE: lower interrater reliability was generally found for videos with a low base rate of events). Coding was complete for 92 videos, some videos were unable to be coded due to technological problems with camera equipment or parents not speaking English. One code from this coding system, Fathers' engagement, was used in the present investigation.

Parent engagement reflected the percentage of the task that the father was actively engaged with the child during the task. Engagement included responses to the child's physical/verbal bids, providing a command or instruction to the child, physically interacting with the child (e.g. hugs, demonstrating how to play with bubbles), etc.

Paternal Responsivity- Play

Parenting Interactions with Children: Checklist of Observations Leading to Outcomes
The following are the items of the PICCOLO (Roggman, Cook, Innocenti, Jump, & Christiansen, 2013) observed and coded during the Three Bags Task.

<u>Affection</u>

1. speaks in a warm tone of voice
2. smiles at child
3. praises child
4. is physically close to child
5. uses positive expressive with child
6. is engaged in interacting
7. shows emotional warmth

<u>Responsiveness</u>

1. pays attention to what child is doing
2. changes pace or activity to meet child's interests or needs
3. is flexible about child's change of activities or interests
4. follows what child is trying to do
5. responds to child's emotions
6. looks at child when child talks or makes sounds
7. replies to child's words or sounds

<u>Encouragement</u>

1. waits for child's response after making a suggestion

2. encourages child to handle toys
3. supports child in making choices
4. supports child in doing things on his/her own
5. verbally encourages child's efforts
6. offers suggestions to help child
7. shows enthusiasm about what child is doing

<u>Teaching</u>
1. explains reasons for something to child
2. suggests activities to extend what child is doing
3. repeats or expands child's words or sounds
4. labels objects or actions for child
5. engages in pretend play with child
6. does activities in a sequence of steps
7. talks to child about characteristics of objects
8. asks child for information

Toddler Emotion Regulation Behaviors

All videos are to be coded in 10 second segments, or "epochs"

Toy behind the barrier consists of 24, 10-second coded epochs.

- 30sec Play with Toy [NOT coded]
- 1 minute behind barrier [Behind Barrier A; b1, b2, b3, b4,b5,b6]
- 30sec Play with Toy [Play A; p1, p2,p3]
- 1 minute behind barrier [Behind Barrier B; b7, b8, b9, b10,b11,b12]
- 30sec Play with Toy [Play B; p4, p5,p6]
- 1 minute behind barrier [Behind Barrier C; b13, b14, b15, b16,b17,b18]

b = behind barrier; p = play

<u>Determining start and stop times.</u>

- b: start coding for the first 10 second epoch as soon as the toy is placed behind the barrier
- p: start coding for the first 10 second epoch as soon as the toy is given to the child (either handed to the child or placed on the table near the child).
    - In the case that the <u>research assistant</u> (RA) attempts to give the child the toy and the child refuses, commence coding when the phone is offered to the child (even if the child doesn't take it or if the RA doesn't immediately set it on the table near the child)

<u>Codes Utilized</u>

- 1 = behavior present in the epoch
- 0 = behavior absent in the epoch

- 997 = kid is too dysregulated and RA ends task early
- 999 = administration error and the task isn't there
    - for example, the video turns off, the task is administered incorrectly, etc.
- Note: there should be at least 7 seconds of an epoch available to code it. If there are fewer than 7 seconds of data, please use one of the missing data codes (997 or 999)

<u>Coded behaviors will cover the following domains</u>:

**Note: Variable names for codes follow description

1. Attention Bid
    a. Attention bid to caregiver
        i. Vocalization [AVC_b1]
            1. Child makes a sound or says a word directed toward caregiver
        ii. Physically reaching [APC_b1]
            1. Child reaches with arms toward caregiver
    b. Attention bid to RA
        i. Vocalization [AVR_b1]
            1. Child makes a sound or says a word directed toward RA
        ii. Physically reaching [APR_b1]
            1. Child reaches with arms toward RA
2. Social Referencing
    a. Child directed gaze at caregiver's face [SGC_b1]
    b. Child directed gaze at RA's face [SGR_b1]
3. Distraction: prolonged or intense attention to another object in the room, or manipulating or playing with objects in the room
    a. Distraction related to study protocol [DP_b1]
        i. Including: <u>intentionally</u> playing with high chair strap, electrodes, wires
    b. Distraction related to head
        i. touch face [DF_b1]
        ii. touch hair/head [DH_b1]
        iii. thumb sucking [DT_b1]
    c. Distraction-Other
        i. Intentionally counting fingers, pretending to draw on table, others [DOI_b1]
        ii. Unintentional: playing with hands, rubbing legs, clutching neck [DOU_b1]
            1. For example, child would not be paying attention to the behavior she is doing
4. Engagement with the barrier
    a. Touching/reaching for the barrier [EB_b1]
5. Physical Actions
    a. Physical action relates to more aggressive actions, including:
        i. kicking the table [PK_b1]
        ii. pounding the fist on the table [PP_b1]
        iii. squeezing out of chair [PS_b1]

            iv. hitting at phone when presented to child from RA [PH_b1]
                1. Note: if child is touching phone with force while playing with it, code as "Orienting to Task Object"

6. Orienting to task object
    a. Orienting to task object includes:
        i. looking at phone [OL_b1]
            1. Note: child can receive a point for looking at phone AND touching phone
        ii. touching or manipulating phone [OT_b1]
            1. Note: if child is hitting phone when RA is handing phone to child, code as "Physical Action"
7. Cognitive Reappraisal
    a. Child looks quizzically at caregiver [CC_b1]
        i. Note: should be over questioning (e.g. cocking neck, says "huh", hands raised in questioning manner)
    b. Child looks quizzically at RA [CR_b1]
        i. Note: should be over questioning (e.g. cocking neck, says "huh", hands raised in questioning manner)

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ABSTRACT

FATHERING AND TODDLER EMOTION REGULATION: INTERGENERATIONAL CAREGIVING AND PARASYMPATHETIC PROCESSES

by

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August 2018

Advisors: Dr. Erika Bocknek and Dr. Douglas Barnett

Major: Psychology (Clinical)

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Emotion regulation is an essential component of adaptive childhood development that is rooted in complex and interacting environmental and biological systems (Hastings et al., 2008). Caregivers play an integral role in promoting their children's emotion regulation (Morris et al., 2007), while children's individual physiology affects how they react and respond to the caregiving environment (Beauchaine, 2015). Few studies have examined paternal influence on child emotion regulation, especially among low-income and African American families with toddlers. To address this limitation, the current study investigated relations among three contexts of fathering, parasympathetic regulation, and toddler emotion regulation. This study (N = 92) describes data from fathers (90% African American, 67% annual income < $15,000) and their toddlers (*M* age = 29.64 months; 60% boys). Data were collected as part of a broader, ongoing study examining family resilience among urban children and their parents. Fathers reported on their own emotion dysregulation (EDS, Bradley et al., 2011), while parenting was assessed during two observed interactions: 1) a post-stressor family reunion; and 2) a play task. Child and paternal respiratory sinus arrhythmia (RSA) was also obtained as an index of parasympathetic arousal (Mindware Technologies, LTD, Westerville, OH). Findings demonstrated a robust association between

fathering and toddler emotion regulation, such that paternal emotion dysregulation and engagement following a stressor emerged as significant predictors. Further, toddler RSA moderated the associations between fathering and emotion regulation, such that toddlers with moderate and elevated levels of resting RSA benefitted from paternal emotion regulation and parenting engagement following a stressor. Fathering during play did not have a direct or indirect effect on toddler emotion regulation. Together, results from this study emphasize the importance of fathering on toddler emotion regulation, and present important findings related to the roles of both caregiving and physiologic contexts in early regulatory development.

AUTOBIOGRAPHICAL STATEMENT

Patty Richardson was born and raised in Michigan. Her interest in clinical psychology developed while she completed her undergraduate education at the University of Michigan. During these formative years, she began employment at a psychiatric hospital working with children and adolescents on an inpatient unit. This rewarding and challenging work impacted the course of her career as she sought to understand the etiology of early trajectories of psychopathology and perhaps, more importantly, learn to ameliorate these pathways. Her interest in the science of resilience lead to her seek out a position as a research assistant, then research coordinator, at the University of Michigan Department of Psychiatry from 2009-2012. She assisted with a series of studies related to maternal and infant mental health and wellbeing, including a basic science study examining the effects of maternal childhood trauma exposure on parenting (PI Dr. Maria Muzik), and intervention studies aimed to reduce peripartum depression (PI Dr. Heather Flynn) and support parenting practices among at-risk mothers of young children (PIs Dr. Katherine Rosenblum, Dr. Maria Muzik). As a doctoral trainee at Wayne State University, she received clinical and research training at Children's Hospital of Michigan (2013-2017) where she provided therapy services to socioeconomically and medically at-risk children and families and conducted research on adolescent attachment relationships (PI Dr. Douglas Barnett) and parenting psychoeducation for mothers of newborns (PI Dr. Erika Bocknek). Patty's current research program aims to better understand the interplay of environmental and physiological processes that can explain how many underprivileged children develop well, with a focus on the role of supportive fathering. In August 2017, Patty will commence her predoctoral, APA-accredited internship at the University of Tennessee Health Science Center, with placement at St. Jude Children's Research Hospital. She anticipates graduating with her PhD in Fall 2018.