THESIS

PATERNAL INVOLVEMENT AND DYADIC AFFECTIVE FLEXIBILITY IN PARENT-CHILD COREGULATION

Submitted by

Mark R. Cunningham

Department of Human Development and Family Studies

In partial fulfillment of the requirements

For the Degree of Master of Science

Colorado State University

Fort Collins, Colorado

Summer 2017

Master's Committee:

Advisor: Erika Lunkenheimer

Rachel Lucas-Thompson
Ruoh-Nan Yan

ABSTRACT

PATERNAL INVOLVEMENT AND DYADIC AFFECTIVE FLEXIBILITY IN PARENT-CHILD COREGULATION

The present study examined the role of paternal involvement in parent-child positive affect and dyadic flexibility. Previous research has shown that father's involvement may provide contextual support that may protect dyadic subsystems from stressors and promote positive parenting practices within the family unit. Additionally, involved fathers develop more sensitive relationships with their children. Thus, it was hypothesized that parent-child dyads with greater paternal involvement would show greater positive affect and dyadic flexibility, which has been shown to result in children's decreased externalizing problems. Mother-child (n = 209) and father-child dyads (n = 88) interacted in a block design task at home when children were 3 years old. Dynamic systems-based methods were used to derive dyadic positive affect and dyadic flexibility from observational coding. Mother's self-report was used to determine paternal involvement in comparison to all potential caregivers. The results of this study did not show a relation between paternal involvement and dyadic positive affect and flexibility. Implications of these findings are discussed and provide new directions for research into parent-child coregulation dynamics.

TABLE OF CONTENTS

INTRODUCTION

Paternal Involvement and Dyadic Affective Flexibility in Parent-Child Coregulation

Over the past 50 years, researchers have cultivated interest in paternal caregiving and have begun to investigate the potential importance of fathers' role within family systems and the impact of this role on children's developmental trajectories (Bianchi, Robinson, & Milke, 2006). The extant literature on primary caregivers has been dominated by research concerning mothers who have traditionally assumed this role. The paucity of research concerning paternal primary caregiving inaccurately suggests that fathers rarely serve as primary caregivers within family systems and that father-child relationships have limited influence on child development (Cabrera, Tamis-LeMonda, Bradley, Hofferth, & Lamb, 2000). On the contrary, the 2011 U.S. Census report indicates that almost 7 million fathers provide primary care, defined as the most hours per week, to their children (Laughlin, 2013). Similarly, a Pew Research report from 2014 suggests that the number of fathers serving as the primary caregiver (without additional employment outside of the home) reached 2 million, doubling the incidence reported in 1989 (Livingston, 2014). This transformation of traditional caregiving roles within the family calls for more research examining how these changes impact the family system and child development (Cabrera, Tamis-LeMonda, Bradley, Hofferth, and Lamb (2000); (Finley & Schwartz, 2006; Rohner & Veneziano, 2001).

In particular, it is not clear through which mechanism(s) father involvement in caregiving differentially impacts the father-child and mother-child family subsystems (i.e., dyads) in comparison to mother involvement (Lunkenheimer, Olson, Hollenstein, Sameroff, & Winter, 2011). For instance, increased father involvement may provide the mother with increased

support, thus decreasing her stress and allowing her to be more responsive to her child (Feldman, 2000). An understanding of alternative mechanisms will elicit a more thorough comprehension of how fathers' involvement may influence the interpersonal relationships, which act as the mechanisms that lead to adaptive vs. maladaptive development (Lunkenheimer & Dishion, 2009). Additionally, little is known about the contribution of father involvement to children's development of self-regulation. Self-regulation is critical for a child to manage their emotions and bodily functions and sustain attention and focus (Gillespie & Seibel, 2006). A greater ability to self-regulate allows the child to have more effective and favorable experiences with peers and adults when they are agitated or ashamed (Kostelnik, Gregory, Soderman, & Whiren, 2011). Young children learn to regulate themselves from reciprocally regulating interactions that are scaffolded by trusted caregivers in their environment (Tronick, 1989). Developmental psychologists will be able to understand how these reciprocally regulating interactions or coregulation processes differ when paternal involvement varies and how this alters microsocial interactions in interpersonal relationships and subsequently developmental trajectories such as self-regulation within the family system.

Paternal Involvement

The family system is comprised of four different systems once a child has been brought into the system, the mother-child, father-child, husband-wife or parent-parent in nonheterosexual family structures, and the higher-order family system. All of these systems are mutually related and influenced by the others; the developments of the other two dyadic subsystems influence the third dyadic subsystem, and their collective interactions transact to form higher-order family process (Minuchin, 1985). An example of this thinking proposed by McHale and Fivaz-Depeursinge (1999) would encourage researchers to not only take into account the marital

quality of the parents, but also the father's psychological preparation for parenthood, and involvement in early duties of parenting, combined with mother's feelings about the role men should take in parenting, will shape the foundation for what will become the family process. With this understanding, fathers who display higher involvement may have already had the psychological readiness for parenthood or are raising children with mothers who encourage the parenting role of the father, thus setting the tone for more attuned interactions in the family system.

This extant literature surrounding the construct of paternal involvement suggest that it influences the functioning of the family systems. For example, paternal involvement has been identified as a protective factor that buffers against marital decline and maternal stress (Feldman, 2000). The increased support at home from fathers serves as a form of environmental support for mothers, allowing them the opportunity to dedicate more mental and physical effort towards parenting (Belsky, 1984). Mothers who receive more social support have been found to concurrently exhibit decreased rates of maternal depression and higher maternal sensitivity (Feldman, 2000; Levy-Shiff, 1994). Together these findings suggest that father involvement may provide contextual support that may protect dyadic subsystems from stressors and promote positive parenting practices within the family unit.

Research has also shown that father-child interactions provide unique developmental opportunities that support successful adaption for children. For example, in a study by Feldman (2007), in which patterns of infant affect during interactions with mothers and fathers were examined, the authors found that fathers were more likely than mothers to engage in interactions, wherein the father-infant dyad experienced more recurrent high positive arousal, which arose more suddenly and was able to be attained from any preceding state. Fathers also showed more

adaptive interactions than the mother, exhibited by greater affective matching of the infant's positive arousal, highlighting moments of heightened emotionality via mutual affect. Whereas the affective interactions with mother displayed more neutral states with gradual change (Feldman, 2007). Feldman (2003) also states that a higher degree of mismatching in affective states occurs between infant sons and mothers, which increases the need for the natural coordination with the father to help stabilize the infant's experiences of coregulation. Under optimal situations, infants should have opportunities to experience affective coregulation with a gender matching and mismatching parent, thus allowing practice in diverse modes of arousal regulation (Feldman, 2003). Furthermore, the importance of parental synchrony, defined as the matching of affective states used during face to face interactions to create and maintain positive affect, or absence (prolonged work hours, death, separation or divorce) may be most crucial at times of reorganization, such as entering school or adolescence (Feldman, 2003). This creates the basis for the present study to examine the importance the father contributes to coregulatory processes as the infant transitions into the toddler stage, which has been previously shown to be a stage where fathers take on a more invested role in parenting (Belsky, Rovine, & Fish, 1989). This affective matching or synchrony in parents' and children's behavioral and emotional displays and physiological conditions improves children's self-regulatory capacity such as management of novelty, unpredictability, and sudden changes in arousal (Calkins, 2011; Feldman, 2012). This provides another example of how coregulation processes may differ given the environmental differences that the system is interacting within.

Additionally, Feldman (2007) and colleagues reported that when the father-infant dyad is engaged in play (relative to when the mother-infant is in play), the dyad has decreased focus on one another due to increased interaction in the external environment. Thus, affect tends to arise

abruptly, regularly, and without preparation, which may allow the infant to explore their surroundings and contribute to their ability to participate in intense and novel moments given the secure base brought about through the concurrent interactions between the dyad. Whereas traditionally, the mother and father's secure base with the infant mainly served to promote effective care and a sense of safety (Grossmann & Grossmann, 2005). This study suggests that this unique form of interaction between the father and infant may allow the father to successfully serve as a secure base that the infant may operate to explore new environments and engage in novel experiences (Feldman, 2007; Grossmann, Grossmann, Fremmer-Bombik, Kindler, & Scheuerer-Englisch, 2002). Lastly, involved fathers develop more sensitive relationships with their children, evidenced by higher degrees of reciprocity, adaptation, responding to interactive bids from the child, and positive affect compared to less involved fathers (Feldman, 2000).

Moreover, this unique father-child interaction explained previously is supported by Bronfenbrenner's ecological theory wherein fathers serve as microsystem partners that may engage in favorable "proximal processes" to facilitate healthy child development (Pleck, 2007). Proximal process has been defined as "progressively more complex, reciprocal interactions between an active, evolving, biopsychological human organism and the persons, objects, and symbols in its immediate environment" (Bronfenbrenner, 1994, p. 1644). For example, Parke (2002) has proposed that the rough-and-tumble play exhibited by fathers may serve as a mechanism to scaffold the child's developing emotion regulation (ER). Using a proximal process lens, fathers' use rough-and-tumble play more than mothers (Pleck, 2007); this form of play bolsters a child's ability to interpret and manage emotions and distinguish between innocent play and aggression (Boyd, 2013). Thus, the dyadic relationships children co-create with father

and mother differentially influence the development of the child's specific self-regulatory patterns in substantively meaningful ways (Feldman, 2007).

Interestingly, mothers and fathers have been shown to display similar responses to infant's bids for connection such as eye gazing, shortened or repeated words, and feeding techniques, which indicates no physiological based sex differences between men and women towards infants (Lamb, Pleck, Charnov, & Levine, 1987). These researchers also explain that just because men and women can be equally responsive does not mean they always are: men's responsiveness can differ based on the amount of involvement they provided during infant care since caretaking experience appears to lead toward increased responsiveness. As a father practices responsiveness more and more, the parent-child dyad and ultimately the family system may organize itself to be increasingly more attuned and responsive based on the roles established early on.

Prior research has also examined the impact that paternal absence has on a wide array of family and child outcomes. For instance, boys raised with very limited to no father involvement develop increased competitive behavior, aggression, and hold negative views in regards to feminine characteristics more than their matched peers with involved fathers (Bjorklund & Ellis, 2014; Draper & Harpending, 1982). Additionally, these boys also have problems in psychosocial adjustment and self-control (Cabrera, Tamis-LeMonda, et al., 2000; Hetherington & Stanley-Hagan, 1986). Additionally, girls without involved fathers experience difficulty in forming long-term relationships with men, earlier sexual experiences, and earlier onset of menarche (Tither & Ellis, 2008). The developmental impact of absent fathers tends to be less pronounced with female versus male offspring (Cabrera, Tamis-LeMonda, et al., 2000; Draper & Harpending, 1982; Moffitt, Caspi, Belsky, & Silva, 1992), however, children raised without involved fathers

are more prone to experience mental health issues, drop out of school, earn less money, and experience a divorce of their own (Gray & Anderson, 2010; Sigle-Rushton & McLanahan, 2004).

Together these findings concerning paternal influences suggest that children with little to no father involvement will lack the opportunities to experience the differing coregulatory interactions that fathers exhibit with children, thus reducing their exposure to different modes of arousal regulation that would benefit them in future interactions in peer groups and adult life (Feldman, 2003). The analysis of dynamic interaction patterns as they evolve within the family system in the toddler years will allow developmental psychologists to parse out the putative mechanisms that may explain how these differences that arise in association with paternal involvement.

Dynamic Systems Theory and Coregulation

The developmental trajectories of children are molded by proximal, microsocial interactions that occur throughout the lifespan (Bronfenbrenner & Morris, 1998). These interactions can be understood by utilizing a dynamic systems (DS) perspective, wherein the shared experiences of the parent-child dyad are reciprocal causal interactions (Dumas, Lemay, & Dauwalder, 2001; Hollenstein, Granic, Stoolmiller, & Snyder, 2004). The shared micro-interactions within the parent-child dyad combine to develop patterns of communication (Patterson, 1982), or coregulation. These cumulative interaction cycles form transactional processes in which a child exhibits affect, the parent responds with a reciprocal affect expression, which influences the child's next expression of affect and so on. As time progresses, these behavioral or affect cycles can solidify into rigid dyadic interaction patterns in which new

behavior or affect is inhibited in favor of more predictable alternatives, which may become problematic for the child and present as aggression or depression (Hollenstein et al., 2004).

Dynamic systems theory allows researchers to understand how a dynamic system of diverse, interconnected parts transforms and operates over time. Additionally, DS theory answers the question of how new configurations and organizational patterns arise as humans develop (Lunkenheimer & Dishion, 2009). A benefit of using this DS approach is that researchers are able to examine individual variation in these configurations and patterns to determine how these facets, such as paternal involvement in this example, alter these patterns (Lunkenheimer & Dishion, 2009). These systems are not closed to external environmental conditions or information, but rather they are open systems that pull information from the environment, which modifies new forms and organizational patterns (Thelen, Smith, Karmiloff-Smith, & Johnson, 1994). Dynamic systems are self-organizing wherein; they are constantly taking in new information that is being incorporated into the smaller or microsystem aspects of the system to improve the internal organization, while the overall organization of the system is maintained (Lunkenheimer & Dishion, 2009).

Coregulation occurs within dyads that comprise the family system; the multiple interdependent relationships form a specific experiential milieu (Caldera & Lindsey, 2006). A family's dyadic subsystems (mother-child, father-child, and mother-father) present opportunities for developing processes of coregulation to interact and develop across microlevel time scale (e.g. seconds) to the macrolevel (e.g. years). Children cultivate unique patterns of coregulation with each parent, beginning in the infant stages. These unique patterns differentially contribute to diverse developmental outcomes (Feldman, 2003). The quality of coregulation can be stronger or more attuned, based on a greater matching of expressed emotion or affect, or can be

weaker or less attuned to one another (Olson & Lunkenheimer, 2009). The quality and patterns, which will be described later through the constructs of dyadic affective flexibility or rigidity, are both important in understanding the development of self-regulation. Unfortunately, there is a paucity of research on the unique contributions of the father's involvement to these dynamic regulatory processes. Conceptualizing the specific patterns of coregulation between children and their parents will expand our understanding of how different degrees of paternal involvement are associated with a child's capacity to regulate affect (Feldman, 2003).

Children's development of self-regulation has been identified as a fundamental milestone during early childhood (Olson & Lunkenheimer, 2009), and, as such, it is critical that we understand how dynamic interactions within family subsystems scaffold children's development of these regulatory processes. In early childhood, children undergo accelerated development across domains that service regulatory capacity, including cognitive, behavioral, emotional and social domains (Calkins, 2007). The development of self-regulation can be bolstered by parents' attempts to facilitate skill development in these domains (Olson & Lunkenheimer, 2009). One method parents' use to scaffold self-regulation is the shared coregulation cycles explicated above, and specifically through their expression of affect. The ability of young children and infants to moderate the expression and experience of affect is treated as an essential construct in theories of attachment, temperament, socialization, and psychopathology (Lunkenheimer et al., 2011). Therefore, this study will explore how paternal involvement is associated with a dyad's flexibility in affect expression, thus providing a greater understanding of how the unique interaction between the father-child dyad is expressed.

Dyadic Affective Flexibility and Rigidity

The comparison of dyadic affective flexibility and rigidity within a dyad provides one way to characterize coregulation patterns. Dyadic affective flexibility occurs when a dyad is able to express an expanded array of behavioral repertoire, whereas a more rigid dyad will have the tendency to get "stuck" in a dyadic state that may be problematic, which has been displayed in parents with depressive symptoms who are drawn toward negative states (Lunkenheimer, Albrecht, & Kemp, 2013). These states are known as attractor states, wherein a dyadic system (parent-child) is drawn towards certain states more often than other affective states. For example, when a dyad reaches a state of reciprocal antagonism, and this happens frequently, it can be known as an attractor state for a specific family that indicates they often are drawn towards an antagonistic state, and once the hostility has initiated, it is onerous to escape the pattern (Hollenstein et al., 2004). This provides an example of how real-time microlevel interactions operate the evolution of attractors, which represent the macrolevel organization of the system that the interaction resides within (Lunkenheimer & Dishion, 2009).

Dyadic rigidity occurs when an individual or dyad has a diminished behavioral repertoire and a limited capacity to change behaviors in response to the environment (Hollenstein et al., 2004). Dyadic affective flexibility and positive affect, which tend to accompany one another, are related to reductions in externalizing behavior problems such as fighting, and disobeying rules (Lunkenheimer et al., 2011). The alternative, dyadic rigidity, has been associated with higher externalizing and internalizing behavior (Hollenstein et al., 2004).

Dyadic affective flexibility brings about opportunities for children to experience and express a range of emotions, which permits children extensive opportunities to modulate those emotions and become proficient at regulating themselves in social environments (Gottman, Katz,

& Hooven, 1996). Additionally, when a child experiences a positive and flexible dyadic interaction, they display adaptive interpersonal interactions, which lay the foundation for the child's ensuing self-regulatory capacity (Lunkenheimer et al., 2011). To summarize, the level of experience of both positive and negative affect indicates relationship quality within the parent-child dyad (Collins & Russell, 1991).

Current Study

The current study aims to answer the following questions: Are levels of paternal involvement associated with dyadic positive affective flexibility of mother-child and father-child dyads? I hypothesize dyads with greater paternal involvement will display greater dyadic positive affective flexibility. Thus, I will be testing two hypotheses: Mother-child dyads who report greater paternal involvement will show greater positive affective flexibility, and father-child dyads with greater paternal involvement will show greater positive affective flexibility.

METHODS

Participants

This study is based on data that were collected for a larger longitudinal study, which evaluated young children who were at risk for school-age conduct problems (Olson & Sameroff, 1997). Thus, the methods described here are those that are relevant for this study.

The majority of families (95%) were recruited from daycare facilities through fliers and newspapers relating to both "difficult-to-manage" and normative toddlers; pediatricians and preschool teachers referred others. The participants were contacted for prescreening to ensure they met the criteria for the study. This included maternal ratings on the Child Behavior Checklist/ 2-3 (CBCL; Achenbach, 1992); in the original study, researchers oversampled for the medium-high to high range of the Externalizing Problems Scale (39% with $T > 60$, 30% with $T = 50–60$, and 31% with $T < 50$). Children undergoing serious risk factors such as pervasive developmental disorders or economic hardship were excluded to avoid overwhelming subtler effects in question. After reviewing the DS-based indices of flexibility for four mother-child and three father-child dyads, we decided to remove them from the sample because their observation times were too brief (under 3 min); analyses with father-child dyadic data resulted with 88 participants, whereas analyses on mother-child dyads had 209 participants.

The children were evaluated at three years of age ($M = 37.7$ months, $SD = 2.7$ months, range = 27–45 months) (Lunkenheimer et al., 2011). The participants were representative of the local population, wherein 86% of European American heritage, 5% African- American, and 8% biracial. The majority of the sample was married 89%, with 5% single, 3% cohabiting, and 3% divorced. Nineteen percent of mothers and 24% of fathers obtained high school educations, 34%

of fathers, and 46% of mothers had completed four years of college, and 35% of mothers and 42% of fathers had an additional graduate or professional training (Lunkenheimer et al., 2011). The median annual family income was $52,000, ranging from $20,000 to over 100,000. The occupational status mean was 7.58 on Hollingshead's (1975) occupational scale (range = 2-9, SD = 1.59), indicating the minor professional category. Fifty-five percent of mothers worked full-time outside of the home. Participants were 244 children (51% male) with an average age of 37.5 months and their parents whose age was (M = 36.59, SD = 6.23) for fathers and (M = 34.38, SD = 5.25) for mothers.

Procedure

The participants underwent a two-hour semi-structured interview by a female social worker. Following the interview, the parent-child dyad was recorded for an hour while conducting an interaction task in which the dyad built various block designs borrowed from the Wechsler Intelligence Scale for Children-Revised (Wechsler, 1974). Parents were instructed to guide children to complete the red and white block designs from the guidebook in succession. Fathers and mothers were observed separately and on different occasions. The adjusted sample included 163 mothers; however, scheduling conflicts reduced the amount of fathers who were able to participate in the home assessment resulting in 94 fathers. Families were paid $100 for each session of data collection they participated in.

The parent-child dyad was video recorded (fathers and mothers on separate occasions) while conducting a block design task that is designed to challenge the dyads' regulatory skills (Wechsler, 1991). The task is an accepted assessment of intelligence for children between the ages of 6 and 16. The block design task was selected in the original study because it had a defined goal and conferred a challenge greater than the child's cognitive capability, therefore

parental input was necessary for completion. The dyads attempted to complete three block designs that gained difficulty and were given by the experimenter. There was no determined time limit by the experimenter. The average interaction times for mother-child dyads were 5.71min (SD= 2.66 min, range= 3-16 min) and father-child dyads were 6.53 min (SD= 2.88 min, range= 3-17min). The parent-child dyad was coded for affect while conducting the block task at 30-s intervals on the T1 observation. The affect was coded into ordinal data with four levels: negative, neutral, low positive, and high positive (see Measures for a description of affect coding).

Measures

Paternal involvement. Mothers reported the average percentage of caregiving time that each parent (mother and father) typically engages in. Thus, this variable is based on the mother's perception of what caregiving involvement entails. The questionnaire allowed mothers to list up to eight potential caregivers and the percentage of involvement for each caregiver ranging from (1) Mom (2) Dad (3) Sibling – (8) Daycare (9) Preschool. These caregiver categories accumulated to 100%, and if the father was not listed as a caregiver, but the total involvement reached a 100% (i.e. mother and daycare with 50% each) the father was given a 0% involvement score.

Affect coding. The coding indicators for parents' affective states are as follows. For a "low" positive indicator, more than one occurrence of a warm variation in tone of voice and/or the presence of smiles with eye contact, or an occurrence of higher positive affect such as a laugh and smile. The "high" positive indicator was registered by more than one occurrence of laughter, singing or physical affection. For parents' negative affect was coded by an occurrence irritability or annoyance as revealed through an irritated vocal tone, narrowing eyes, or frowning.

Children's negative and positive affect was coded equivalently but integrated developmentally pertinent behaviors (e.g., screech of satisfaction, crying, and temper tantrums). Neutral affect was coded in the absence of either positive or negative affective states.

Two undergraduate research assistants and three doctoral students conducted affect coding. Reliability analysis was conducted on 40% of the sample utilized in coding. Coders were evaluated for coder drift reliability at regular intervals. The average weighted kappa values: K=0.96 for parent negative affect, 0.89 for parent positive affect, 0.99 for child negative affect, and 0.92 for child positive affect. The use of weighted kappas was included to address relative concordances that may exist, which is important for an ordinal coding system; for instance, the difference between neutral and high positive is weighted more heavily than between low positive and high positive affect. Any disparities in coding were settled through consensus.

SSGs. The composition of all potential states for a dyad is called a state space (Hollenstein et al., 2004). SSG methodology allows researchers to track transitions in flexibility and rigidity by calculating the number of spaces visited divided by the duration of each visit for each dyad to obtain a single variable representing the rate of affective flexibility per time spent in expression. These measures of affective flexibility between mother-child and father-child dyads will be associated with the degree of paternal involvement ratio reported by the mother. The present study highlighted differences in states of affective flexibility and rigidity onto a state space grid (SSG) modified for observation of parent-child interactions (Granic & Lamey, 2002). The dyadic flexibility and affect variables were derived from the preceding coding system and calculated using SSGs in Gridware 1.1 (Lamey, Hollenstein, Lewis, & Granic, 2004). The Gridware program involves a graphical approach that employs observational data to quantify two ordinal variables that represent a state space for the system (see (Hollenstein, 2007). The

sequence of dyadic states is plotted as it advances in real time on a grid constituting all possible behavioral amalgamations of the dyad.

At the outset, positive and negative affect for both individuals in a dyad could be three potential levels (none, low, high). Later, the matrix of affective dyadic states was condensed for analytic purposes, and so the "none" levels of positive and negative affect were combined into a single category depicting neutral affect. Additionally, negative behaviors for parents and children were very infrequent, thus "low" and "high" levels of negative affect were combined into a single negative affect code. These modifications resulted in a 4 X 4 or 16-cell grid with the four behaviors negative affect, neutral affect, low-positive affect, and high-positive affect on each axis. Child behaviors were plotted on the *x*-axis and parent behaviors were plotted on the *y*-axis, with mother–child and father–child interactions plotted on independent graphs. Therefore, the combination of parent and child codes occurring in each 30-s time interval formed a dyadic state for that time unit that was expressed in one of the 16 cells of the grid (e.g., mother low positive–child neutral). If a positive and negative affect state occurred within one time interval, negative affect was plotted not positive. This decision was determined from research showing that negative affect carries more weight than positive affect in interpersonal interactions (Gottman, 1996; Ito, Larsen, Smith, & Cacioppo, 1998). According to this prior research, we expected that concurrent positive affect would be less influential in the wake of a negative interchange.

Dyadic affect. Dyadic positive affect was calculated as the duration of time (the number of 30-s intervals) the dyad spent in which both parent and child displayed low- or high-positive affect based on the SSG. This variable equated the duration of time the dyad spent in only 4 out of the 16 possible cells (i.e., parent low–child low, parent low–child high, parent high–child low,

parent high–child high). Total task time was controlled in all primary analyses. Generally, negative affect was skewed towards the "none" level in these interactions (e.g., skewness = 6.57, SE = 0.16 for mothers; skewness =. 4.39, SE = 0.16 for children with their mothers). Thirty-nine percent of mother–child dyads and 43% of father–child dyads showed negative affect during the interaction. Thus, the base rates of negative affective content across the sample were too low to calculate a dyadic negative affect variable using real-time, dynamic-systems methods. Both the mother-child and father-child dyadic affect variables were skewed and log transformed prior to analyses.

Dyadic flexibility. We calculated dyadic flexibility by examining variation in affective states using a specific characteristic of dyadic interaction patterns. This characteristic was obtained from the 16-cell SSG including all levels and types of affect (negative, neutral, low positive, and high positive). The characteristic used was range, which was measured using a count of the number of unique cells visited on the grid. A greater number of unique cells visited indicated the use of a greater range of affective states and therefore greater dyadic flexibility. The mother-child dyadic flexibility variable was skewed and was transformed prior to analyses.

Data Analysis

All key variables were screened for normality and transformed if significant non-normality was evident prior to running the model. Also, preliminary analyses were performed on the following sociodemographic and control variables to see if they needed to be included in the final models: child sex, mother's education, father's education, mother's marital status, and family socioeconomic status (SES). Both parent-child multiplicative interaction dependent variables were created after centering the original variables. Primary hypotheses were tested using multiple regression analyses. First, paternal involvement was entered as the predictor,

controlling for relevant demographic characteristic (child sex and mother marital status). Second, two models were conducted to evaluate mother-child dyadic positive affective flexibility and father-child dyadic positive affective flexibility as the outcome variables. Interaction outcome variables were tested separately and were interpreted following procedures in (Aiken, West, & Reno, 1991). All statistical analyses were performed using SPSS v.24.0.

RESULTS

Bivariate Analyses

Based on prior literature, family socioeconomic status (SES), child sex, mother's education, father's education, child sex and mother's martial status was examined as potential control variables for the analyses, see **Table 1**. We examined bivariate correlations for these covariates and none of them were significantly correlated with the variables of interest besides mother's marital status. Paternal involvement was significantly different based on mother's marital status $t(238) = 6.7$, $p < .01$, wherein mothers who were not married to the child's father had significantly less paternal involvement, so marital status was retained in the final model. Child sex was also retained in the model due to previous research that reported father-child dyads displayed greater range and dispersion of affect when the child was male (Lunkenheimer et al., 2011). No significant differences were found in father-child dyadic positive affective flexibility based on child sex, $t(86) = 1.05$, $p = .30$ or mother's marital status $t(86) = -1.09$, $p = .28$. Additionally, no significant differences were found in mother-child dyadic positive affective flexibility based on child sex $t(206) = .55$, $p = .58$ and mother's marital status $t(204) = .04$, $p = .97$. Bivariate correlations and descriptive statistics are displayed in Table 1. Furthermore, the variables for dyadic positive affect and flexibility were intercorrelated in both father-child and mother-child interactions.

Table 1. *Descriptive statistics for and Bivariate Associations Between Main Variables of Interest* [a]

	1	2	3	4	5
1. Paternal Involvement %	X				
2. M - C Dyadic Affect	.01	X			
3. M - C Dyadic Flex	.04	.67**	X		
4. F - C Dyadic Affect	-.18	.15	-.04	X	
5. F - C Dyadic Flex	-.13	.10	-.01	.55**	X
M [b]	20.12	6.27	7.85	2.60	9.64
SD	11.17	4.32	4.21	2.63	5.04

Note: M-C, mother-child; F-C, father-child.

[a] *M-C analyses N=209; F-C analyses N=88*

[b] *M* and *SD* are presented before standardizing, but the standardized variables were used in analyses.

*$p < .05$

** $p < .01$

Multivariate Analyses

The primary research question aimed to investigate if father-child and mother-child dyads with mothers who reported higher paternal involvement displayed greater parent-child dyadic positive affect and affective flexibility. Analyses were performed individually for mother-child and father-child interactions in SPSS. A multiple linear regression analysis was used to test if paternal involvement, child sex, and mother's martial status significantly predicted mother-child dyadic positive affect and flexibility. The results of the test were non-significant (R^2 =.002, F(3,200) = .16, p=.93). An additional multiple linear regression was used to test if paternal involvement, child sex, and mother's marital status significantly predicted father-child dyadic positive affective flexibility. The results of this test were also non-significant (R^2 =.04, F(3,82) = 1.25, p=.30). Therefore, overall analysis indicated that there was not a significant association between paternal involvement, child sex, and mother's marital status in relation to both mother-child and father-child dyadic positive affective flexibility. Power analyses using GPower (Faul, Erdfelder, Buchner, & Lang, 2009) indicated that these analyses had adequate power to detect moderate and large effects ($1-\beta > .86$) but limited power to detect small effects ($1-\beta < .37$) (Cohen, 1988). The results are presented in **Table 2**.

Table 2. *Regressions Predicting Maternal and Paternal Dyadic Affective Flexibility based on Paternal Involvement Percentage*

	M-C Dyad Affective Flex	F-C Dyad Affective Flex
Variable	*b* (SE)	*b* (SE)
Paternal Involvement %	.00 (.01)	.01 (.01)
Child Sex	-.09 (.15)	-.33 (.25)
Mother Marital Status	.00 (.25)	.70 (.42)
R^2	.00	.04

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

DISCUSSION

The purpose of this study was to examine how differing levels of paternal involvement related to the dyadic interaction processes within the family system. Specifically, this study aimed to explore how the percentage of paternal involvement is associated with both mother-child and father-child dyadic coregulation mechanisms of positive affect and affective flexibility. My hypothesis was that mother-child dyads that reported greater paternal involvement display greater positive affect and affective flexibility. Additionally, I predicted that father-child dyads with a higher percentage of paternal involvement display more positive affect and affective flexibility. Although the results did not support my hypotheses, I would like to discuss the potential reasons why paternal involvement was not associated with parent-child dyadic affective flexibility and what other factors are important to consider going forward.

More involved fathers have been shown to develop more sensitive relationships with their children, exhibited by attunement, reciprocity, and more positive affect (Feldman, 2000), which informed the hypothesis that father-child dyads would show greater dyadic positive affect and flexibility. The paternal involvement construct has been defined and operationalized in myriad ways. Involvement is a broad term that consists of three dimensions: the intensity, nature, and quality of the parent-child relationship (Tremblay & Pierce, 2011; Turcotte, Dubeau, Bolté, & Paquette, 2001). For example, Feldman (2000) captured involvement by assessing each parent's household and childcare responsibilities, the amount of time each parent spends with their infant, and the range of childcare activities each parent performs. However, this study focused on involvement in quantity instead of quality. Thus, it may be more important to measure paternal involvement in terms of quality and to associate this with coregulatory mechanisms.

Furthermore, lacking the other measures of paternal involvement that capture quality in addition to quantity may have caused an inaccurate representation of fathers who dedicate a small amount of time to the child, but when the father is with the child, he may also show high quality parenting behaviors such as sensitivity or attunement to the child. This mislabeling of paternal involvement has been suggested previously by McHale (1999), who posits there exists a great amount of fathers who, despite their limited role in the daily tasks of caregiving, have forged a deep sense of love and affinity for their children, which they observe and celebrate inside and outside of the home environment.

An additional consideration is that paternal involvement was captured by mother's self-report. Obtaining the father's self-report in addition to mother's report would allow researchers to average their reports to obtain a more accurate measure of involvement. For example, although many mothers say that they would like their husbands to be more involved in parenting, a majority of mothers say they do not want their husband to be involved, which has been referred to as maternal gatekeeping, wherein mother's beliefs about parenting roles inhibit a collaboration between men and women in parenting and family work (Schoppe-Sullivan, Brown, Cannon, Mangelsdorf, & Sokolowski, 2008). If mothers did not want the father to be involved in parenting, this may have reduced the marital quality or increased the mother's stress leading to more rigid dyadic flexibility. Since a considerable amount of these mothers were stay at home mothers it is likely that some of these mothers held negative views in regards to the role of fathers as primary caregivers, which may cause mothers to underestimate father's involvement on their their self-reports. Future research should obtain self-reports from the mother and father detailing paternal involvement and the parent's perception of parenting roles to control for these potential effects.

An additional factor of paternal involvement quality is the attachment style of that father. Attachment style has been shown to shape mental representations of the self in association to others, also known as internal working models (Bowlby, 1973). These internal working models also shape our emotion regulation, emotional reactivity, and affective experiences, wherein anxious individuals experience greater emotionl reativity and fluctuations in emotions, wheras avoidant individuals report low emotionality (Pietromonaco, Barrett, & Powers, 2006). Additionally, individuals high in attachment anxiety tend to be highly responsive to signs of distress and will hyperactivate negative thoughts and emotions, whereas individual high in avoidance tend to avoid negative thoughs and emotions by suppression or repression (Mikulincer & Sheffi, 2000). By applying the attachment lens to the present study, it may be that paternal involvement is moderated by the father's attachment style. For example, if a father is highly involved and exhibits high anxious emotionality then the parent-child dyad may be more likely to get stuck in high-negative communication patterns, leading to less positive affect and flexibility. Perhaps paternal involvement is only associated with increased dyadic positive affect and flexibility if the father maintains a securely attached internal working model.

Furthermore, if increased paternal involvement is not a contributor to adaptive coregulatory interactions between parent and child, then it may be that children benefit more from interventions that target the parent's emotion regulation and positive affect. An example of such intervention has been shown in studies targeting mindful parenting behaviors (Duncan, Coatsworth, & Greenberg, 2009). These authors found that parents who practice mindfulness, a state of being aware of one's thoughts, feelings and sensations, leads to greater flexibility, responsiveness, positive affect, relationship satisfaction and less depression, parenting stress and

reactivity. Again, it may be that paternal involvement is associated with coregulatory mechanisms through the mechanism of mindful parenting.

Based on past research showing increased paternal involvement serves as a protective factor for dyadic subsystems, by reducing maternal stress (Feldman, 2000) and increasing maternal sensitivity (Feldman, 2000; Levy-Shiff, 1994), I predicted that mother-child dyads would display greater positive affect and affective flexibility because these mothers would not be as likely to get stuck in rigid dyadic coregulatory patterns as shown in mothers with depression symptoms (Lunkenheimer et al., 2013). Perhaps paternal involvement, as measured in this study, is not influencing the higher-order family process (Minuchin, 1985) and thus, the increased involvement of the father may not be a significant factor that shapes the affective interaction of the mother-child subsystem.

Overall, this study helped to provide a starting point for exploring the role that fathers hold in contributing to coregulatory processes within the parent-child dyadic subsystems. Few researchers have examined the association between involvement and parent-child interaction dynamics such as coregulation. Although the hypotheses of this study were not supported, this research will inform research with dynamic systems based observations of coregulation processes to refine their methodology as they explore the potential contributions of the father in the family system. This study also helped to raise more questions regarding the potential changes in coregulation mechanisms between the different dyads in a family as fathers increasingly take on a larger caregiving role in the United States.

Limitations and future directions

The current study was limited to a restricted range of paternal involvement because a relatively high percentage of mothers in this sample were stay at home mothers. The total

sample's paternal involvement range was from 0-50% with an average of 20%. While the smaller father-child sub-sample had a smaller average of 18.9% for paternal involvement. This limited range may have reduced our ability to detect differences in dyadic positive affect and flexibility based on paternal involvement since the sample did not contain highly involved fathers. It is important that future research recruits some of the 7 million fathers who provided primary care to their children in 2011 to gain an understanding of how the presence of the father alters parent-child interaction dynamics and coregulation mechanisms (Laughlin, 2013).

Another limitation of the current study is that the dyadic affect data used in this study was coded at only one time point in a lab setting with a block design task. Previous research on affective flexibility has found differences between real-time affective dynamics at one time point and affective variability across days and weeks (Hollenstein, 2015). Future research would benefit from observing parent-child dyadic affective interactions in tasks that cause a variety of emotions to be elicited in lab settings and experience sampling of affect across several time points throughout a week (Trull, Lane, Koval, & Ebner-Priemer, 2015). This would allow affective dynamics to be compared across both lab and real world settings, which may provide more opportunities to see variations in dyadic flexibility in other conditions based on differences in paternal involvement.

REFERENCES

Achenbach, T. M. (1992). *Manual for the Child Behavior Checklist/2-3 and 1992 Profile: Profile for boys and girls. Auswertungsbögen*: Department of Psychiatry, University of Vermont.

Aiken, L. S., West, S. G., & Reno, R. R. (1991). *Multiple regression: Testing and interpreting interactions*: Sage.

Belsky, J. (1984). The determinants of parenting: A process model. *Child Development*, 83-96.

Belsky, J., Rovine, M., & Fish, M. (1989). *The developing family system.* Paper presented at the Systems and development. The Minnesota symposia on child psychology.

Bianchi, S. M., Robinson, J. P., & Milke, M. A. (2006). *The changing rhythms of American family life*: Russell Sage Foundation.

Bjorklund, D. F., & Ellis, B. J. (2014). Children, childhood, and development in evolutionary perspective. *Developmental Review, 34*, 225-264.

Bowlby, J. (1973). Attachment and loss: Separation (vol. 2): New York: Basic Books.

Boyd, B. (2013). The Art of Roughhousing: Good Old-Fashioned Horseplay and Why Every Kid Needs It/Big Body Play: Why Boisterous, Vigorous, and Very Physical Play Is Essential to Children's Development and Learning. *American Journal of Play, 5*(3), 386.

Bronfenbrenner, U. (1994). Ecological models of human development. *Readings on the development of children, 2*, 37-43.

Bronfenbrenner, U., & Morris, P. A. (1998). The ecology of developmental processes.

Cabrera, N., Tamis-LeMonda, C. S., Bradley, R. H., Hofferth, S., & Lamb, M. E. (2000). Fatherhood in the twenty-first century. *Child Development*, 127-136.

Cabrera, N., Tamis-LeMonda, C. S., Bradley, R. H., Hofferth, S., & Lamb, M. E. (2000). Fatherhood in the twenty-first century. *Child Development, 71*, 127-136.

Caldera, Y. M., & Lindsey, E. W. (2006). Coparenting, mother-infant interaction, and infant-parent attachment relationships in two-parent families. *Journal of Family Psychology, 20*, 275.

Calkins, S. D. (2007). The emergence of self-regulation: Biological and behavioral control mechanisms supporting toddler competencies. *Socioemotional development in the toddler years: Transitions and transformations*, 261-284.

Calkins, S. D. (2011). Caregiving as coregulation: Psychobiological processes and child functioning *Biosocial foundations of family processes* (pp. 49-59): Springer.

Cohen, J. (1988). Statistical power analysis for the behavioral sciences Lawrence Earlbaum Associates. *Hillsdale, NJ*, 20-26.

Collins, W. A., & Russell, G. (1991). Mother-child and father-child relationships in middle childhood and adolescence: A developmental analysis. *Developmental Review, 11*, 99-136.

Draper, P., & Harpending, H. (1982). Father Absence and Reproductive Strategy: An Evolutionary Perspective. *Journal of Anthropological Research, 38*, 255-273. doi:10.2307/3629848

Dumas, J. E., Lemay, P., & Dauwalder, J.-P. (2001). Dynamic analyses of mother–child interactions in functional and dysfunctional dyads: A synergetic approach. *Journal of abnormal child psychology, 29*, 317-329.

Duncan, L. G., Coatsworth, J. D., & Greenberg, M. T. (2009). A model of mindful parenting: Implications for parent–child relationships and prevention research. *Clinical Child and Family Psychology Review, 12*(3), 255-270.

Faul, F., Erdfelder, E., Buchner, A., & Lang, A.-G. (2009). Statistical power analyses using G* Power 3.1: Tests for correlation and regression analyses. *Behavior research methods, 41*, 1149-1160.

Feldman, R. (2000). Parents' convergence on sharing and marital satisfaction, father involvement, and parent-child relationship at the transition to parenthood. *Infant Mental Health Journal, 21*, 176-191.

Feldman, R. (2003). Infant–mother and infant–father synchrony: The coregulation of positive arousal. *Infant Mental Health Journal, 24*, 1-23.

Feldman, R. (2007). On the origins of background emotions: from affect synchrony to symbolic expression. *Emotion, 7*, 601.

Feldman, R. (2012). Oxytocin and social affiliation in humans. *Hormones and behavior, 61*, 380-391.

Finley, G. E., & Schwartz, S. J. (2006). Parsons and Bales revisited: Young adult children's characterization of the fathering role. *Psychology of Men & Masculinity, 7*, 42.

Gillespie, L. G., & Seibel, N. L. (2006). Self-regulation: A cornerstone of early childhood development. *YC Young Children, 61*, 34.

Gottman, J. M. (1996). *What predicts divorce?: The measures*: Lawrence Erlbaum Associates.

Gottman, J. M., Katz, L. F., & Hooven, C. (1996). Parental meta-emotion philosophy and the emotional life of families: Theoretical models and preliminary data. *Journal of Family Psychology, 10*, 243.

Granic, I., & Lamey, A. V. (2002). Combining dynamic systems and multivariate analyses to compare the mother–child interactions of externalizing subtypes. *Journal of abnormal child psychology, 30*, 265-283.

Gray, P. B., & Anderson, K. G. (2010). *Fatherhood: Evolution and human paternal behavior*: Harvard University Press.

Grossmann, K., & Grossmann, K. (2005). Universality of human social attachment as an adaptive process. *Attachment and bonding: A new synthesis*, 199-228.

Grossmann, K., Grossmann, K. E., Fremmer-Bombik, E., Kindler, H., & Scheuerer-Englisch, H. (2002). The uniqueness of the child–father attachment relationship: Fathers' sensitive and challenging play as a pivotal variable in a 16-year longitudinal study. *Social development, 11*, 301-337.

Hetherington, E. M., & Stanley-Hagan, M. (1986). Divorced fathers: Stress, coping, and adjustment. *The father's role: Applied perspectives*, 103-134.

Hollenstein, T. (2007). State space grids: Analyzing dynamics across development. *International Journal of Behavioral Development, 31*, 384-396.

Hollenstein, T. (2015). This time, it's real: Affective flexibility, time scales, feedback loops, and the regulation of emotion. *Emotion Review, 7*(4), 308-315.

Hollenstein, T., Granic, I., Stoolmiller, M., & Snyder, J. (2004). Rigidity in parent—child interactions and the development of externalizing and internalizing behavior in early childhood. *Journal of abnormal child psychology, 32*, 595-607.

Ito, T. A., Larsen, J. T., Smith, N. K., & Cacioppo, J. T. (1998). Negative information weighs more heavily on the brain: the negativity bias in evaluative categorizations. *Journal of personality and social psychology, 75*, 887.

Kostelnik, M., Gregory, K., Soderman, A., & Whiren, A. (2011). *Guiding children's social development and learning*: Cengage Learning.

Lamb, M. E., Pleck, J. H., Charnov, E. L., & Levine, J. A. (1987). A biosocial perspective on paternal behavior and involvement. *Parenting across the life span: Biosocial dimensions*, 111-142.

Lamey, A., Hollenstein, T., Lewis, M., & Granic, I. (2004). GridWare (Version 1.1). *Computer software]*. http://statespacegrids. *org*.

Laughlin, L. (2013). Who's minding the kids? Child care arrangements: Spring 2011 (Current Population Reports, pp. 70–135). Washington, DC: US Census Bureau.

Levy-Shiff, R. (1994). Individual and contextual correlates of marital change across the transition to parenthood. *Developmental Psychology, 30*, 591.

Livingston, G. (2014). Growing number of dads home with the kids. *Pew Research Center's Social & Demographic Trends Project*.

Lunkenheimer, E. S., Albrecht, E. C., & Kemp, C. J. (2013). Dyadic flexibility in early parent–child interactions: Relations with maternal depressive symptoms and child negativity and behaviour problems. *Infant and child development, 22*, 250-269.

Lunkenheimer, E. S., & Dishion, T. (2009). Developmental psychopathology: Maladaptive and adaptive attractors in children's close relationships. *Chaos and complexity: Recent advances and future directions in the theory of nonlinear dynamical systems psychology*, 282-306.

Lunkenheimer, E. S., Olson, S. L., Hollenstein, T., Sameroff, A. J., & Winter, C. (2011). Dyadic flexibility and positive affect in parent–child coregulation and the development of child behavior problems. *Development and Psychopathology, 23*, 577-591.

McHale, J. P., & Fivaz-Depeursinge, E. (1999). Understanding triadic and family group interactions during infancy and toddlerhood. *Clinical Child and Family Psychology Review, 2*(2), 107-127.

Mikulincer, M., & Sheffi, E. (2000). Adult attachment style and cognitive reactions to positive affect: A test of mental categorization and creative problem solving. *Motivation and Emotion, 24*(3), 149-174.

Minuchin, P. (1985). Families and individual development: Provocations from the field of family therapy. *Child Development*, 289-302.

Moffitt, T. E., Caspi, A., Belsky, J., & Silva, P. A. (1992). Childhood experience and the onset of menarche: A test of a sociobiological model. *Child Development, 63*, 47-58.

Olson, S., & Sameroff, A. (1997). Social risk and self-regulation problems in early childhood. *Bethesda, MD: National Institute of Mental Health*.

Olson, S. L., & Lunkenheimer, E. S. (2009). Expanding concepts of self-regulation to social relationships: Transactional processes in the development of early behavioral adjustment.

Parke, R. D. (2002). Fathers and families. *Handbook of parenting, 3*, 27-73.

Patterson, G. R. (1982). *Coercive family process* (Vol. 3): Castalia Publishing Company.

Pietromonaco, P. R., Barrett, L. F., & Powers, S. I. (2006). Adult attachment theory and affective reactivity and regulation. *Emotion regulation in couples and families: Pathways to dysfunction and health, 1*, 57-74.

Pleck, J. H. (2007). Why could father involvement benefit children? Theoretical perspectives. *Applied development science, 11*, 196-202.

Rohner, R. P., & Veneziano, R. A. (2001). The importance of father love: History and contemporary evidence. *Review of general Psychology, 5*, 382.

Schoppe-Sullivan, S. J., Brown, G. L., Cannon, E. A., Mangelsdorf, S. C., & Sokolowski, M. S. (2008). Maternal gatekeeping, coparenting quality, and fathering behavior in families with infants. *Journal of Family Psychology, 22*(3), 389.

Sigle-Rushton, W., & McLanahan, S. (2004). *Father absence and child wellbeing: A critical review*: Russell Sage Foundation.

Thelen, E., Smith, L. B., Karmiloff-Smith, A., & Johnson, M. H. (1994). A dynamic systems approach to the development of cognition and action. *Nature, 372*(6501), 53-53.

Tither, J. M., & Ellis, B. J. (2008). Impact of fathers on daughters' age at menarche: a genetically and environmentally controlled sibling study. *Developmental Psychology, 44*, 1409.

Tremblay, S., & Pierce, T. (2011). Perceptions of fatherhood: Longitudinal reciprocal associations within the couple. *Canadian Journal of Behavioural Science/Revue canadienne des sciences du comportement, 43*(2), 99.

Trull, T. J., Lane, S. P., Koval, P., & Ebner-Priemer, U. W. (2015). Affective dynamics in psychopathology. *Emotion Review, 7*(4), 355-361.

Turcotte, G., Dubeau, D., Bolté, C., & Paquette, D. (2001). Pourquoi certains pères sont-ils plus engagés que d'autres auprès de leurs enfants? Une revue des déterminants de l'engagement paternel. *Revue canadienne de psycho-éducation, 30*(1), 65-91.

Wechsler, D. (1974). *Manual for the Wechsler intelligence scale for children, revised*: Psychological Corporation.

Wechsler, D. (1991). *WISC-III: Wechsler intelligence scale for children: Manual*: Psychological Corporation.