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The Role of Dynamic, Dyadic Parent-Child Processes in Parental Socialization of Emotion

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Abstract

We investigated what a dyadic framework added to Eisenberg, Cumberland, & Spinrad's (1998) parental emotion socialization model based on the argument that the dynamic organization of emotion in the dyad is more than the sum of its parts and thus makes a unique contribution to emotion socialization. Preschoolers (*N*=235) completed challenging problem-solving tasks with mothers and fathers during which parental emotion-related socialization behaviors (ERSBs), child negative emotional arousal, and dyadic positive emotion data were collected. We examined whether dyadic synchrony of positive emotion at age 3 was a mechanism by which age 3 parental ERSBs impacted children's age 5 aggressive behavior in school, accounting for child gender, child negative emotional arousal, and aggressive behavior in preschool. ERSBs were significantly positively related to dyadic positive synchrony with both mothers and fathers at age 3. Longitudinal models supported an indirect effect, not a moderating effect, of dyadic synchrony: both mothers' and fathers' ERSBs contributed to children's less aggressive behavior at age 5 through the effects of higher dyadic positive synchrony. Findings suggest dynamic, dyadic emotional processes should be considered as a mechanism of emotion socialization and that parent-child positive emotional synchrony is supportive of early childhood emotional development.

Keywords: emotion socialization, emotion expression, parent-child coregulation, dyadic synchrony, aggression, fathers

The Role of Dynamic, Dyadic Parent-Child Processes in Parental Socialization of Emotion

The comprehensive parental emotion socialization model defined by Eisenberg, Cumberland, & Spinrad (1998a) addressed not just the effects of parents' emotion-related socialization behaviors (ERSBs) on children's outcomes, but also the roles of context and culture, individual characteristics, and moderating factors such as relationship qualities. This model spawned empirical investigations that provided an evidence base for ways that various parental ERSBs influence children's socioemotional development. The original model also acknowledged bidirectional causal relations between parent and child. However, it did not address dynamic, dyadic processes, nor the concept that dyadic interaction patterns themselves may be a distinct source of emotion socialization. The present article addresses the need for the inclusion of dynamic, dyadic processes to models of parental emotion socialization.

In the past 20 years, we have learned that dyadic interaction is more than the sum of its parts (Moore et al., 2013) and researchers have theorized that interaction dynamics serve as a mechanism by which parents influence child development (Lunkenheimer & Dishion, 2009). These views are informed by a dynamic systems perspective (Thelen & Smith, 1998), which asserts that behavioral input from the parent and child self-organizes into a higher-order dyadic system that is distinct from the individual parent or child (Granic & Patterson, 2006). When applied to emotion socialization, for example, parent-child synchrony of positive emotion (Feldman, 2007; Harrist & Waugh, 2002) has emerged as a particular dynamic process shown to benefit children's emotional development. Accordingly, we examine the role of dynamic, dyadic parent-child emotional processes using Eisenberg and colleagues' (1998a) model as a guiding framework, and specifically, whether dyadic synchrony of positive emotion between parent and child plays a mechanistic role in emotion socialization processes.

The Parent Emotion Socialization Model

Eisenberg and colleagues' (1998b, p. 317) working definition of emotion socialization is:

> "…behaviors enacted by socializers that (a) influence a child's learning (or lack thereof) regarding the experience, expression, and regulation of emotion and emotion-related behavior and (b) are expected to affect the child's emotional experience, learning of content, and emotion-related behavior in a manner consistent with socializers' beliefs, values, and goals about emotion and its relation to individual functioning and adaptation in society."

These behaviors (ERSBs) include explicit discussion about emotions (e.g., helping children learn how to understand or regulate emotions; Morris et al., 2011), reactions to children's emotions (e.g., responding with support versus dismissal; Lunkenheimer, Shields, & Cortina, 2007), and parent emotional expressions (e.g., warmth versus negativity; Cole, Teti, & Zahn-Waxler, 2003). The model stipulates that the effects of ERSBs on outcomes are mediated by child emotional arousal, defined as the intensity, duration, or frequency of the child's emotional response to the ERSBs. Finally, the model asserts there are moderators of the relation between ERSBs and child outcomes, including temperament, parenting style, and parent-child relationship quality.

Multiple studies have examined subcomponents of the model, though few have done justice to its comprehensive scope. The most common focus has been on child mediators and moderators of the link between ERSBs and child outcomes, particularly the roles of child temperament, self-regulation, and attachment (Eisenberg et al., 2001; Hastings & De, 2008; Laible, 2006; Moed et al., 2016). For example, child effortful control or effortful attention appears to be a mediator of the effects of ERSBs on child self-regulation in both infancy (Volling, McElwain, Notaro, & Herrera, 2002) and childhood (Eisenberg et al., 2005). In contrast to child factors, less is known about parent factors that moderate the effects of ERSBs, though they also appear important (Baker, Fenning, & Crnic, 2011; Zhou et al., 2002). The original model also acknowledged the importance of the "variability and consistency of parental behavior" and to the "fit of behavior with child's developmental level" (Eisenberg et al., 1998b, p. 243); the latter invokes a dyadic quality but research has not yet addressed these factors. We argue that a dynamic, dyadic perspective could help shed light on these processes.

Studies have illustrated the general importance of bidirectional individual parent and child contributions to emotion socialization processes (Feng, Shaw, Skuban, & Lane, 2007; Wilson & Durbin, 2013). However, few have explicitly tested the role of dyadic-level parent-child processes in parental emotion socialization. When dyadic processes are included, they are often conceptualized as an overarching quality based on global coding of parent-child interaction rather than as a dynamic process (Harrist, Pettit, Dodge, & Bates, 1994; Lindsey, Cremeens, Colwell, & Caldera, 2009), and treated as a main predictor of emotion outcomes rather than a mechanism (Cole et al., 2003). For example, mother-child mutually responsive orientation (a global construct similar to dyadic synchrony) predicts young children's self-regulation, an effect that is moderated by children's temperamental negative emotionality (Kim & Kochanska, 2012).

It is not yet clear where dynamic, dyadic parent-child processes fit in a model of parental emotion socialization. Some studies have shown that dyadic or family-level global qualities such as shared positivity (Laible & Song, 2006), dyadic collaboration (Jin, Zhang, & Han, 2017), or family emotional expressiveness (Are & Shaffer, 2016) moderate the effect of ERSBs on child outcomes. Thus, we may expect dyadic qualities to be moderators, which would align somewhat with Eisenberg et al.'s (1998) model in that the fit between parent and child was considered a likely moderator. However, if dynamic exchanges of emotion between parent and child actively shape the socialization process, it may be that dynamic, dyadic processes act as a mediating mechanism through which ERSBs impact child outcomes. We now consider how dynamic emotional patterns between parent and child may contribute uniquely to the socialization of emotion and whether they may mediate emotion socialization processes.

A Dynamic, Dyadic Approach to Emotional Processes

Dynamic systems principles assert that developmental phenomena are organized hierarchically through integrated intrapersonal, interpersonal, and higher-order systemic processes (Sameroff, 1995; Thelen & Smith, 1998). Thus, we expect that parents' and children's emotional input into their interactions self-organizes into a higher-order dynamic system of emotion at the dyadic level (Granic, 2000). For example, when parent and child share positive emotion, feelings from this experience may reinforce positive emotional expression, contributing to a greater likelihood of repeated positive exchanges and thus shaping the predominant levels and valence of emotion the child experiences and through which s/he is socialized. Repeated emotional exchanges may also serve other functions that organize the relationship, such as increasing attachment security in the dyad or offering more opportunities to practice the regulation of negative emotion. Thus, a dynamic system characterized by patterns of emotional exchanges between parent and child can play a direct role in future emotional interactions and children's emotion-related outcomes.

One way that dynamic, dyadic processes may shape emotion socialization is in relation to attractor states. From a dynamic systems perspective, parent and child emotional exchanges are organized into attractor states in which the dyad is "attracted to" particular mutually determined dyadic states. Theoretically, parent positive emotion is more likely to prompt child positive emotion in real time and vice versa (Fredrickson, 2001); this attractor state of coupled positive emotion draws behavior away from other potential states (e.g., dyadic negative emotion states;

Lunkenheimer & Dishion, 2009). These attractors become stable over time and this stability can shape the dyad's future emotional repertoire and influence child outcomes (Fogel, 1993). For example, parents' and adolescents' greater negativity towards each other predicts increases in expressed negative emotion in subsequent interactions (Kim, Conger, Lorenz, & Elder, 2001), and dyadic negative episodes between adolescent peers that become longer over an interaction predict more adolescent antisocial behavior over time (Granic & Dishion, 2003). Stable dyadic negativity generally begets more negative outcomes (Hollenstein, Granic, Stoolmiller, & Snyder, 2004) whereas stable dyadic positivity begets positive outcomes (Lunkenheimer et al., 2011).

Dyadic synchrony of positive emotion has emerged as an adaptive dimension of parent-child emotional dynamics (Feldman, Greenbaum, & Yirmiya, 1999; Moore & Calkins, 2004). Dyadic synchrony is related to dynamic attractor states in that it reflects the coupling of similar behavioral states in proximal time. Generally, emotional synchrony is modeled via concurrent or short time-lag relations between parent and child expressed emotion during face-to-face interactions (Feldman, 2007). However, the construct of synchrony has been operationalized in various ways and on various time scales (1s, 30s, 60s, day-to-day; Crandell, Fitzgerald, & Whipple, 1997; Feldman, 2003; Ferrer & Nesselroade, 2003; Giuliano, Skowron, & Berkman, 2015; Kochanska, Aksan, Prisco, & Adams, 2008; Lindsey et al., 2009). Early work on positive synchrony showed the time-sensitive co-construction of positive emotional states between mother and infant to be necessary in laying the groundwork for the infant's relational and self-regulation skills (Feldman, 2003). In early childhood, work utilizing various operationalizations of dyadic positive synchrony examined on various time scales has shown it is associated with adaptive child outcomes, such as secure attachment (Guo, Leu, Barnard, Thompson, & Spieker, 2015), higher social competence (Dumas, LaFreniere, & Serketich, 1995), better effortful control

(Kochanska et al., 2008), and fewer behavior problems (Lunkenheimer, Ram, Skowron, & Yin, 2017). Presently, we address dyadic synchrony of parent and child positive emotion across 30s intervals in parent-child problem-solving tasks, similar to certain prior studies (Giuliano et al., 2015; Kochanska et al., 2008; Lindsey et al., 2009). The focus on positive emotional synchrony was related to our interest in normative emotional socialization processes, however, it should be noted that there are also research literatures that address broader behavioral synchrony (e.g., Harrist & Waugh, 2002), physiological synchrony (e.g., Davis, West, Bilms, Morelen, & Suveg, 2018), and negative emotional synchrony (e.g., Cole et al., 2003) between parent and child.

If dynamic, dyadic processes have direct effects on children's emotion-related outcomes, then the question remains as to whether they are also mechanisms by which parental ERSBs influence child outcomes – and if so, whether they are indirect or moderating mechanisms of these processes. Specific to emotion socialization research, one study found both mediating and moderating effects of mother-child emotional reciprocity, calculated via sequential time series analyses, on child outcomes: positive reciprocity mediated the effects of marital conflict on negative peer behavior, whereas negative reciprocity moderated these effects, with higher positive and lower negative reciprocity linked to better outcomes (Lindsey, Caldera, & Tankersley, 2009). Another study found parent-child dyadic collaboration moderated pathways from ERSBs to child emotion regulation to child psychopathology symptoms, with higher dyadic collaboration acting as a buffer (Jin et al., 2017). Thus, prior work suggests constructs related to dyadic positive synchrony may beget positive outcomes or buffer from negative outcomes in emotion socialization processes, but the nature of this mechanism is still unclear. Accordingly, we examined both indirect and moderating pathways of influence to better clarify this role.

Present Study

The present study aimed to extend the parental emotion socialization model delineated by Eisenberg and colleagues (1998a) by testing the role of dynamic, dyadic parent-child positive synchrony in relations between parental ERSBs and children's emotion-related outcomes. First, we examined whether the ERSBs of mothers' and fathers' emotional responsiveness and expressiveness were related to concurrent dyadic positive synchrony with their preschoolers (age 3 years). Both mothers and fathers were examined because a better understanding of dynamic, dyadic processes between father and child is needed, and prior findings show that responsiveness by both mothers and fathers (Davidov & Grusec, 2006; McDowell, Kim, O'Neil, & Parke, 2002) and father-child positive synchrony and comparable constructs (Kochanska et al., 2008; Lindsey et al., 2009) predict children's better outcomes (e.g., self-regulation). Mother-child and father-child processes were examined separately because prior work suggests that dynamic, dyadic processes operate differently by parent, with less cyclic and synchronous patterns, higher levels of emotional arousal, and greater emotional flexibility characteristic of father-child dyads (Feldman, 2003; Kochanska & Aksan, 2004; Lunkenheimer et al., 2011).

Second, we examined whether dyadic positive synchrony played an indirect or moderating role in the relation between parental ERSBs in preschool (age 3) and children's aggressive behavior in kindergarten (age 5). We examined dynamic, dyadic positive synchrony as both an indirect and moderating mechanism given that comparable global dyadic constructs have shown evidence for both mediating and moderating effects (Jin et al., 2017; Lindsey et al., 2012). Aggressive behavior was selected as an outcome because prior studies have demonstrated a link between ERSBs (e.g., parental emotional expressiveness) and child aggression (Eisenberg et al., 2005; Lindsey, Caldera, & Rivera, 2013), suggesting the importance of ERSBs for the regulation of emotion-related behaviors. Aggressive behaviors are also an observable and common form of dysregulated emotion-related behavior in school and are likely to prompt difficulties for the child in other domains such as academics or peers (Moed et al., 2016).

Also in line with Eisenberg and colleagues' (1998a) original model, we accounted for three covariates: 1) child gender, given established differences in ERSBs (Eisenberg et al., 1998a) and aggressive behavior (Chaplin, Cole, & Zahn-Waxler, 2005) by gender; 2) child negative emotional arousal, to reflect the child's individual contribution, as noted in Eisenberg and colleagues' original model (1998b) and supported by subsequent studies (Eisenberg et al., 2001); and 3) baseline aggressive behavior in preschool, to examine the effects of ERSBs and dyadic positive synchrony accounting for stability in teacher-rated aggressive behaviors over time (Smith, Calkins, Keane, Anastopoulos, & Shelton, 2004). We hypothesized that dyadic positive synchrony would act as a mechanism of the effects of ERSBs on children's aggressive behavior in kindergarten, but did not hypothesize specific differences between indirect or moderating effects, nor between mothers and fathers.

Method

Participants

Participants were 235 children (51.9% male) and their mothers, fathers, and teachers enrolled in a longitudinal study on child behavior problems (Olson et al., 2005). Families were oversampled for externalizing problems ("hard-to-manage children"); 11.1% of children tested within the clinical range ($T \geq 64$) on the Externalizing Problems scale of the Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2000) at study entry. Families with severe mental, physical, or environmental risk factors such as developmental disability or extreme poverty were excluded so as to avoid risk factors that could potentially overwhelm the subtler psychosocial dynamics that constituted the main study focus. Families lived within 40 miles of a mid-sized

Midwestern city and were recruited at daycare centers, preschools, and doctors' offices as well as through newspaper advertisements.

Data were collected at child ages 3 years (T1; *M* = 41.40 mos, *SD* = 2.10) and 5 years (T2; *M* = 68.87 mos; *SD* = 3.84). Median annual family income was $60,000-$70,000. Average parent education level was a Bachelor's degree. Half of mothers (47.7%) stayed home part- or full-time. When employed, according to the Hollingshead (1975) scale, mothers were managers and minor professionals (*M* = 6.74, *SD* = 1.63) and fathers were administrators and lesser professionals (*M* = 7.29, *SD* = 1.92). Parents were 88.5% married, 5.1% single, 3.4% living with their partner, and 3% separated or divorced. Mothers were 91.9% Non-Hispanic White, 4.3% Black, 2.1% Latinx, 1.3% Asian, and 0.4% unreported. Fathers were 87.2% Non-Hispanic White, 8.5% Black, 1.3% Latinx, 1.7% Asian, 0.9% other, and 0.4% unreported.

Both mothers and fathers were invited to participate. The sample included 235 mother-child dyads and 173 father-child dyads at T1. Of fathers who participated, only 117 had father-child interaction task data due to some fathers electing not to participate in this portion of the study. Missing values were missing completely at random for mother-child, χ^2 (108) = 116.31, ns, and father-child dyads, χ^2 (76) = 96.45, ns (Little, 1988). There were no differences in child gender, age at T1, or kindergarten aggressive behavior in families whose fathers participated versus did not. Socioeconomic status was higher, $t(85.81) = 2.67$, $p < .01$, and preschool aggressive behaviors were lower, $t(185) = -2.14$, $p < .05$, in the 173 families with participating fathers compared to those without. There were no significant differences in T1 preschool aggressive behavior between families who dropped out at T2 (17 families) and those who did not, $t(185) = 0.31$, ns. All study materials and protocols for the study "Social Risk and Self-

Regulation Problems in Early Childhood" were approved by the Institutional Review Board at the University of Michigan, protocol # BO3-00003400-R1.

Procedure

At T1, a female social worker visited families in-home to administer assessments. Mothers and fathers were assessed on separate days and visits lasted three hours; visits were scheduled in random order based on parents' availability but mothers were observed first more often than fathers. Each parent participated in videotaped interaction tasks with the child, one being the block design task used in the present study. Parents were also provided questionnaires to complete separately, to be returned via mail or retrieved by study staff at a later date. Families received $100 for participating. At T1 and T2, teachers were asked to fill out questionnaires about the child's behavior in the classroom. Questionnaires were returned via mail or retrieved by an experimenter, and teachers received $20 for participating at each time point.

Measures

Parent-child interaction: Dyadic block design task. In T1 home assessments, mothers and fathers completed a videotaped parent-child task in which they guided children through three block designs of increasing difficulty from a guidebook using four plastic cubes (Lunkenheimer et al., 2011). Designs were from the Wechsler Intelligence Scale for Children – Third Edition, an intelligence test for children ages 6 to 17 years (Wechsler, 1991), and two sets of designs were counterbalanced across mothers and fathers. The task was designed to be a cognitive challenge for children, who were younger than 6 years at T1 and thus required guidance to complete the task. Parents were asked to help their children as they normally would and allotted as much time as needed to finish; most tasks lasted 5-7 minutes ($M_{mothers}$ = 343s, $M_{fathers}$ = 418s).

In line with prior work (Chang & Olson, 2016), coders later rated parent and child expressed emotion in 30s intervals and assigned global scores for emotional responsiveness (see below).

Observational coding. Parent and child positive and negative expressed emotion were identified by coders in 30s intervals across the block task. Emotional expressions were based on vocal tone, gaze, facial expression, and body language, and each dimension (positive, negative) was rated on a 3-point scale with possible values of 1 (“none”), 2 (“low”), and 3 (“high”). Examples of positive emotion included warm physical contact, smiles, shared eye contact, and positive vocal inflection. At each 30s interval, “none” was coded if the participant displayed no positive emotion. “Low” reflected more than one instance of low-intensity positive emotion (e.g., smile, warm tone) or one instance of higher-intensity positive emotion (e.g., laughter). “High” reflected more than one instance of high-intensity positive emotion (e.g., singing, laughter, physical affection) in the context of overall positivity (e.g., warm vocal tone, shared gaze). Examples of negative emotion included clear frustration or annoyance, furrowed brows, eye rolling, and harsh vocal tone. At each 30s interval for negative emotion, “none” was coded if the participant displayed no negative emotion. “Low” reflected one instance of low-intensity negative emotion (e.g., irritation, annoyance). “High” reflected multiple instances of low-intensity or any instance of high-intensity negative emotion (e.g., yelling, child tantrum).

Coders included three doctoral students and one post-baccalaureate and one undergraduate research assistant. Interrater reliability was established on 40% of the sample at a criterion of .80. Weighted kappa was used to account for perfect and relative agreements where differences are weighed more heavily when codes are farther apart on the scale (e.g., high vs. none). Average weighted kappas were .96 for child negative emotion, .92 for child positive emotion, and .89 for parent positive emotion. Disagreements were resolved by consensus.

Child negative emotional arousal. Negative arousal was operationalized as the child's maximum level (i.e., intensity) of negative emotion expressed across all 30s intervals of the block design task. This operationalization was selected to align with Eisenberg et al.'s (1998) definition, reflecting the intensity of arousal to the parent with whom the child was interacting, and also to maximize variability in a laboratory study of a community sample wherein expressed negative emotion was low on average. Possible scores were 1, 2, or 3 per the coding scheme described above. Children who showed no negative emotion were assigned a 1. Children who showed "low" negative emotion (but never "high") were assigned a 2; those showing "high" negative emotion at any interval were assigned a 3. Negative arousal was calculated with mothers and fathers separately for respective inclusion in mother-child and father-child models.

Dyadic positive synchrony. Dyadic positive synchrony was operationally defined as the duration of time parent and child expressed the same intensity of positive emotion (e.g., matched high positive or matched low positive, as compared to neutral or negative emotion) over the course of the block design task, based on affect coded in 30s intervals. It was calculated via dynamic systems-based methods that allowed for the assessment of changes in dyadic emotional states, specifically State Space Grids (SSGs) in Gridware 1.15 (Hollenstein, 2007; Lamey, Hollenstein, Lewis, & Granic, 2004). Sample SSGs illustrating low versus high dyadic positive synchrony are shown in Figure 1.

We created SSGs for each dyad (mothers and fathers separately) in which child and parent emotion on a scale from negative to positive defined the X and Y axes, respectively. Due to lower base rates of negative emotion, "low" and "high" negative emotion were collapsed to represent one negative emotion category. Similarly, "none" scores for negative and positive emotion were collapsed to form an overall neutral category. Thus, SSGs had four possible emotion codes for both parent and child (negative, neutral, low positive, and high positive), resulting in a 4 X 4 or 16-cell grid. Each cell on the SSG represented a dyadic state in which a particular valence/intensity of emotion for parent and child were paired (Figure 1); for this study, the dyadic states of interest were: 1) parent low positive x child low positive and 2) parent high positive x child high positive, reflecting episodes in which parent and child were synchronous in both positive valence and intensity of expression. Trajectories of dyadic emotion over time were plotted on the grids, where each node in the trajectory plotted reflected the parent and child's emotion expression in a 30s time interval. The total duration of time in seconds that the dyad spent in these two matched positive states was summed to quantify dyadic positive synchrony.

Parental emotional expressiveness. Based on the coding system described above, mothers' and fathers' positive emotion for each 30s interval of the task were averaged to create an overall positive emotional expressiveness score for each parent. Since possible emotion scores for each interval were 1 ("none"), 2 ("low"), and 3 ("high"), an emotional expressiveness score of 1 would represent mothers and fathers who displayed no positive emotion across the entire duration of the block design task. In comparison, an average score of 3 would represent mothers and fathers who exhibited at least two higher-intensity instances of positive emotion (e.g., singing, laughter, physical affection) during each 30s interval of the block design task.

Parental emotional responsiveness. Coders assigned a global emotional responsiveness score based on parents' ability to anticipate and respond to child emotion cues in the block task. Behaviors ranged from supportive (e.g., labeling feelings, managing negative affect, offering encouragement and comfort) to unsupportive (e.g., failure to generate interest, insufficient responses to children's emotions, disinterest, and criticism) on a scale from 4 (excellent) to 1 (poor). A 4 indicated quick responsiveness, anticipation of child emotion cues, and consistent enthusiasm for the task; 3 indicated moderate responsiveness and some enthusiasm or labeling of emotions; 2 indicated some responsiveness but no anticipation of child distress or loss of interest; 1 indicated unresponsiveness to child emotion cues. Interrater reliability was established on 40% of the sample ($k = 0.95$). Disagreements were resolved by consensus.

Children's aggressive behavior. At T1, children's aggressive behavior in preschool was measured using the 23-item Aggressive Behavior subscale from the Caregiver-Teacher Report Form (CTRF 1½-5; Achenbach, 1997). At T2, the 20-item Aggressive Behavior subscale from the TRF 6-18 was used to rate aggressive behavior in kindergarten (Achenbach & Rescorla, 2001). Teachers reported the frequency of child behaviors in the preceding six months on a 3-point scale ranging from "Not True" (0) to "Very/Often True" (2). Aggressive Behavior scores were calculated by summing these items. Sample items included, "Argues a lot," "Cruelty, bullying, or meanness to others," and "Defiant, talks back to staff." Cronbach's alphas were 0.94 and 0.95 at T1 and T2, respectively. Approximately 6.42% of children at T1 and 4.74% at T2 tested within the clinical range ($T \geq 70$) on the Aggressive Behavior syndrome subscale.

Socioeconomic status (SES). The Hollingshead Four Factor Index (1975) scale was used to measure SES at T1 using mothers' and fathers' self-reported education and occupation. Education was scored on a scale from 1 ("less than seventh grade") to 7 ("graduate or professional training") and occupation was scored from 1 ("farm laborers/menial service workers") to 9 ("higher executives, proprietors, and major professionals"). SES scores for each parent were created by multiplying the education score by three and occupation score by five and then summing the products. Each family received an overall SES score based on the SES of the working parent(s) only; in instances where both parents worked, their scores were averaged.

Results

Preliminary Analyses

All variables were tested for normality. Variable distributions for father-child dyadic positive synchrony, child negative emotional arousal, and kindergarten aggressive behavior revealed high kurtosis and were log transformed prior to analysis. The only significant relations between sociodemographic factors and primary study variables included: 1) SES was modestly positively related to mother-child dyadic synchrony, $r = .18$, $p < .05$; 2) child gender was related to paternal ERSBs such that fathers demonstrated greater emotional responsiveness, $t(115) = 2.16$, $p < .05$, and higher average positive emotion, $t(115) = 2.44$, $p < .05$, with boys than with girls; 3) child gender was related to outcomes such that teachers reported significantly higher levels of aggressive behavior in boys versus girls in kindergarten, $t(181.95) = 2.10$, $p < .05$.

Table 1 outlines means, standard deviations, and bivariate correlations for primary study variables. Parental ERSBs were positively correlated with dyadic positive synchrony for both mothers and fathers. Maternal and paternal emotional responsiveness were positively intercorrelated. Children's negative arousal with mothers and negative arousal with fathers were also positively intercorrelated. Higher paternal responsiveness and expressiveness were both related to children's lower negative arousal with mothers. Finally, higher maternal emotional responsiveness and dyadic positive synchrony with mothers were both related to lower aggressive behavior in kindergarten.

Main Analyses

Our analytic goal was to test the role of dynamic, dyadic processes, specifically dyadic positive synchrony, in the context of Eisenberg and colleagues' (1998a) parental emotion socialization model. First, we examined whether mothers' and fathers' ERSBs of emotional responsiveness and expressiveness were positively related to concurrent dyadic positive synchrony at age 3. Second, we examined whether dyadic positive synchrony was an indirect mechanism in the effects of mothers' and fathers' concurrent ERSBs such that there would be indirect effects of higher parental ERSBs at age 3 on lower child aggressive behavior in kindergarten at age 5 via the effect of higher dyadic positive synchrony. Third, we examined whether dyadic positive synchrony moderated the effects of mothers' and fathers' concurrent ERSBs such that relations between ERSBs at age 3 and kindergarten aggressive behavior at age 5 would vary by levels of dyadic positive synchrony.

To test these questions, we performed longitudinal structural equation modeling in Mplus (Muthén & Muthén, 1998-2012), accounting for the covariates of child gender, child negative emotional arousal, and preschool aggressive behavior. Indirect and moderation effects were tested separately by parent, resulting in four total models; mothers and fathers were tested separately due to prior research indicating differences in dynamic interaction patterns by parent (Feldman, 2003; Kochanska & Aksan, 2004). We used full information maximum likelihood estimation, which accommodates missing data by estimating each parameter using all available data for that parameter. Fit criteria for structural equation models included Ξ^2, root mean square error of approximation (RMSEA; < 0.06 indicates good fit), comparative fit index (CFI; > 0.95 indicates good fit), and standard root mean square residual (SRMR; < 0.08 indicates good fit) (Hu & Bentler, 1999).

Given that the effects of two ERSBs were examined in each model, we followed specific recommendations for tests of indirect effects in structural equation models in which multiple indirect effects are tested simultaneously (Hayes, 2009; MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002; von Soest & Hagtvet, 2011). These guidelines stipulate that an overall association between the independent and dependent variables, namely Step 1 in Baron &

Kenny's (1986) model, is not a necessary condition for mediation and that emphasis should be put on the statistical significance of the indirect effects (Shrout & Bolger, 2002). Statistical tests of indirect effects were examined with confidence intervals calculated using the Monte Carlo method in R (Selig & Preacher, 2008; Preacher & Selig, 2012). The second standard condition for testing mediation (Step 2; Baron & Kenny, 1986) was met per preliminary analyses noted above indicating that parental ERSBs were significantly correlated with dyadic positive synchrony. For moderation models, multiplicative interaction terms were calculated between each of the two respective ERSBs and dyadic positive synchrony (Baron & Kenny, 1986) and included as predictors of children's aggressive behavior alongside ERSBs, dyadic positive synchrony, and covariates.

Mother indirect effects model. In the mother indirect effects model of ERSBs and covariates predicting dyadic positive synchrony and children's aggressive behavior, model fit was good, χ^2 (5) = 3.17, ns, CFI = 1.00, RMSEA = .00, SRMR = .02. Standardized model parameters for significant pathways are shown in Figure 2. Mothers' ERSBs of emotional responsiveness and emotional expressiveness were both positively related to dyadic positive synchrony and child negative arousal was negatively related to dyadic synchrony at age 3. Dyadic positive synchrony was in turn negatively related to children's aggressive behavior in kindergarten at age 5. Monte Carlo tests (Selig & Preacher, 2008) showed significant indirect effects of maternal emotional responsiveness, estimate = -0.0355, 95% CI [-0.0899, -0.0001] and maternal emotional expressiveness, estimate = -0.1629, 95% CI [-0.3303, -0.0279] on children's aggressive behavior through dyadic positive synchrony. These effects were found accounting for stability in children's aggressive behavior from ages 3 to 5 years. Overall this model explained

22% of the variance in dyadic positive synchrony with mothers (R^2 = .22, *SE* = .05, $p < .001$) and 23% of the variance in aggressive behavior in kindergarten (R^2 = .23, *SE* = .06, $p < .001$).

Father indirect effects model. In the father indirect effects model of ERSBs and covariates predicting dyadic positive synchrony and children's aggressive behavior, model fit was good, χ^2 (5) = 6.28, ns, CFI = 0.98, RMSEA = .03, SRMR = .03. Standardized model parameters for significant pathways are shown in Figure 3. Fathers' ERSBs of emotional responsiveness and emotional expressiveness were both positively related to dyadic positive synchrony. Dyadic positive synchrony was in turn negatively related to children's aggressive behavior in kindergarten at age 5. Monte Carlo tests (Selig & Preacher, 2008) showed a significant indirect effect of paternal emotional expressiveness on children's aggressive behavior through dyadic positive synchrony, estimate = -0.2896, 95% CI [-0.6294, -0.0335], but the indirect effect for paternal emotional responsiveness did not meet significance, estimate = -0.0527, 95% CI [-0.1352, 0.0003]. These effects were found accounting for stability in children's aggressive behavior from ages 3 to 5 years. In contrast to the mother indirect effects model, child negative arousal was not related to dyadic synchrony with fathers. Further, paternal ERSBs were related to child gender such that fathers showed higher levels of emotional responsiveness and expressiveness with boys, and child negative arousal with fathers was positively related to preschool aggressive behavior. Overall this model explained 29% of the variance in dyadic positive synchrony with fathers (R^2 = .29, *SE* = .07, $p < .001$) and 22% of the variance in children's aggressive behavior in kindergarten (R^2 = .22, *SE* = .06, $p < .001$). Invariance testing indicated a lack of significant difference in indirect effects models between mothers and fathers, χ^2_{diff} (1, 234) = 3.171, *ns*.

Mother moderation model. In the mother moderating effects model of ERSBs, dyadic positive synchrony, the two respective interaction terms between ERSBs and synchrony, and covariates predicting children's aggressive behavior, model fit was good, χ^2 (5) = 1.20, ns, CFI = 1.00, RMSEA = .00, SRMR = .01. Dyadic positive synchrony was once again positively related to ERSBs and negatively related to child negative arousal as shown in the indirect effects model. However, there were no significant moderating effects of dyadic positive synchrony on the relation between emotional responsiveness or emotional expressiveness and children's aggressive behavior in kindergarten. This model explained 21% of the variance in aggressive behavior in kindergarten (R^2 = .21, *SE* = .05, p < .001).

Father moderation model. In the father moderating effects model of ERSBs, dyadic positive synchrony, the two respective interaction terms between ERSBs and synchrony, and covariates predicting children's aggressive behavior, model fit was good, χ^2 (5) = 4.02, ns, CFI = 1.00, RMSEA = .00, SRMR = .03. Similar to the father indirect effects model, dyadic positive synchrony was positively related to ERSBs, fathers' ERSBs were higher with boys, and higher child negative arousal was positively related to preschool aggressive behavior. Additionally, child gender was positively related to preschool aggressive behavior such that aggression was higher in boys, β = -0.15, *SE* = .07, p < .05. The test of the moderating effect of dyadic positive synchrony on the relation between paternal positive emotional expressiveness and children's aggressive behavior was not significant. Overall, this model explained 27% of the variance in children's aggressive behavior in kindergarten (R^2 = .27, *SE* = .06, p < .001).

Discussion

The present findings offered empirical support that dynamic, dyadic parent-child emotional processes in early childhood make a unique contribution to emotion socialization.

Dyadic positive synchrony was positively related to emotional responsiveness and emotional expressiveness in both mothers and fathers, suggesting that global measures of parental ERSBs are positively related to real-time, dynamic interaction patterns such as dyadic synchrony. Further, we found that dyadic positive synchrony with both mothers and fathers was an indirect mechanism in relations between parental ERSBs and children's aggression in kindergarten, accounting for child gender, child negative emotional arousal with that parent, and baseline aggression in preschool. In comparison, there was no support for a moderating role of dyadic positive synchrony in relations between parental ERSBs and children's aggressive behavior.

Dyadic interaction is more than the sum of its parts, and dynamic parent-child interaction patterns may contribute adaptively or maladaptively to socioemotional development (Hollenstein et al., 2004; Lunkenheimer et al., 2011; Lunkenheimer et al., 2017). Our findings suggest that when parents offered greater emotional support to the child and expressed more positive emotion themselves, it may have prompted more opportunities for positive emotional synchrony in the dyad. Extant literature suggests that negative emotional dynamics are likely to beget constraints on the dyad's emotional repertoire (Granic & Dishion, 2003; Kim et al., 2001) akin to functionalist theories of emotion about the narrowing functions of anger and sadness to meet emotional goals (Campos, Barrett, Lamb, Goldsmith, & Stenberg, 1983). In contrast, our interest was in positive dynamic processes, which may broaden emotional thought-action repertoires per the broaden-and-build theory of positive emotions (Fredrickson, 2001). Dyadic positive synchrony may offer children practice in coordinating positive emotions with others, which may beget additional positive emotions and increase opportunities for building socioemotional skills.

We are still in the early stages of understanding how dynamic parent-child coregulation patterns influence emotion socialization within and across time. The use of dynamic methods such as State Space Grids allows for a closer inspection of mechanistic processes that are not always revealed by more static, global indicators of parent-child interaction (Hollenstein, 2007). Such methods allow for a better understanding of dynamic attractor states in interpersonal interactions, which are thought to lend stability to adaptive or maladaptive relationship processes (Granic, 2000). For example, repeated episodes of positive synchrony may help stabilize positive attractor states, making it more likely that the dyad's baseline state is a positive one, reinforcing relationship quality and secure attachment. These influences may then buffer the child from the development of dysregulated and aggressive behavior. In this way, we can delineate how microlevel processes relate to macrolevel relationship profiles to better understand how adaptive and maladaptive patterns develop over time.

If dyadic positive synchrony is an important process by which children experience, coordinate, and regulate emotions, then it follows that it may have stronger indirect or mediating effects than moderating effects in emotion socialization processes. Eisenberg and colleagues (1998a) proposed that individual child factors mediated relations between ERSBs and child outcomes, whereas dyadic factors such as relationship quality were moderating factors. This perspective addressed dyadic qualities as somewhat global styles of the parent-child relationship, which make sense as moderating factors; for example, relations between ERSBs and child outcomes could vary by dyadic secure versus insecure attachment (Guo et al., 2015). However, our results suggest that dynamic, dyadic processes may be more likely to be an indirect mechanism through which the development of children's emotion-related behaviors are supported. Dynamic systems theory would suggest that individual emotional inputs shape the dyadic dynamic system, which by its open, self-organizing nature, subsequently changes the individuals and the dyadic system with time, going beyond bidirectional effects or more static contextual influences (Granic, 2000; Ram, Shiyko, Lunkenheimer, Doerksen, & Conroy, 2014). This perspective lends itself to the exploration of mechanistic processes such as mediation, or beyond mediation to dynamic analytic models that account for hierarchically organized systems operating on multiple time scales (Chow, Ram, Boker, Fujita, & Clore, 2005; Cole, Bendezú, Ram, & Chow, 2017) in order to capture the complex dynamics of human emotion.

The present findings build on literature indicating that dyadic positive synchrony and related constructs are related to less child aggression, over and above individual child and parent factors and stability in aggressive behavior (Eisenberg et al., 2005; Lindsey et al., 2013). Thus, dyadic positive synchrony may be a fruitful target in the prevention of aggressive behavior. Some evidence-based family interventions already emphasize the parent's sensitive and timely responding to child cues (e.g., Attachment and Biobehavioral Catch-Up; Bernard, Meade, & Dozier, 2013), or use tools such as a bug-in-the-ear microphone to help parents track and respond to child cues in real time (Parent-Child Interaction Therapy; Eyberg, 1988), which may promote dyadic positive synchrony. This support for consistent parental responding may also promote children's competence as they perceive their communicative bids to their parents to be more effective. More empirical research is needed to determine if these therapeutic methods do in fact boost dyadic synchrony (Crotwell, Hernandez-Reif, & Curtner-Smith, 2013).

Our findings also contribute to a needed expansion of research on father-child interactions. We know that father-child dyadic relationship processes matter for child emotion outcomes (Kochanska et al., 2008; Lindsey et al., 2009); our findings offer additional evidence for the importance of dynamic, positive emotional processes between father and child specifically. Both mothers' and fathers' emotional responsiveness and emotional expressiveness were positively related to dyadic positive synchrony with their children, which in turn predicted children's lower aggressive behavior over time. Model parameters were comparable in degree and direction for mothers versus fathers, and invariance testing suggested no differences in model fit. Thus, the effects of dyadic positive synchrony on child aggressive behavior appear similar for mother- and father-child interactions, even if overall levels of synchrony have been shown to be lower with fathers (Kochanska & Aksan, 2004). This finding echoes prior work showing that flexibility of positive affect in both mother- and father-child interactions is beneficial for children's behavioral adjustment in early childhood (Lunkenheimer et al., 2011). It may be that shared positive emotion between parent and child, regardless of the differences in emotion episode that may characterize mothers versus fathers (e.g., duration, intensity), serves to reduce children's aggressive behavior. If so, the promotion of synchronous positive emotion may be an important target with both mother- and father-child dyads in family intervention.

Limitations

We examined aggressive behaviors in children overrecruited for behavior problems, but overall they were not high: approximately 6% of children fell in the clinical range for aggressive behavior syndrome based on T-scores. Thus, the findings may generalize to community samples but not to children with clinical aggression. Similarly, there were low levels of child negative emotional arousal overall as is common of community-based lab studies, which led to our investigation of maximum rather than average levels; higher-risk samples may net more variability in negative arousal with which to better examine how it covaries with dyadic socialization processes. Additionally, our sample was not diverse in ethnicity, family structure, or SES; future research will need to replicate these findings in more diverse samples for adequate generalizability. Our *n* for father-child observations was large relative to the available literature on fathers, and statistical power was not of concern for the models selected, but future replications with larger subsamples of fathers would still be helpful in comparing father and mother effects and/or examining within-child processes across mother- and father-child dyads.

Our analytic models were restricted to the use of 30s intervals in calculating synchrony based on the coding system available. The construct of synchrony has been operationalized at multiple time scales (e.g., 1s, 30s, 60s, day-to-day; Crandell et al., 1997; Feldman, 2003; Ferrer & Nesselroade, 2003; Kochanska et al., 2008; Lindsey et al., 2009) and defined as including lead-lag relations that may play out over short time periods (Feldman, 2003). However, affective expressions can change quickly and thus dynamic affective synchrony often involves modeling of concurrent or very closely time-lagged behaviors (i.e., within seconds). Thus, our findings should be interpreted as reflecting synchrony in proximal emotional expressions by parent and child that may include both simultaneous and lead-lag incidents, and should be interpreted in terms of emotional processes that play out on more of a minute-to-minute scale. In general, the field lacks empirical standards at different developmental stages that attest to the appropriate time scale on which to measure dyadic coregulatory processes such as synchrony: although microscopic second-to-second analyses are appropriate for many affective (and related physiological) processes, rigorous comparison of various time scales is needed in future work. For example, as microlevel processes stabilize, they may form mesolevel rhythms in the parent-child relationship (Lunkenheimer & Dishion, 2009); accordingly, investigation of dyadic patterns across minutes, hours, and days may reveal key mechanisms in developmental pathways to adaptation or maladaptation over time.

Additionally, we examined indirect effects involving dyadic positive synchrony, but given that ERSBs and dyadic positive synchrony were assessed during the same task at the same time point (T1) per the data available, we cannot claim causal effects of ERSBs on dyadic synchrony. Future work with more data points could be used to examine these causal effects.

Future Directions

In future research, more attention to parent and dyadic indirect, mediating, and moderating factors will be important in fully optimizing Eisenberg and colleagues' (1998a) emotion socialization model. Extant work emphasizes that dyadic processes are often parent-driven in the early years (e.g., Kochanka & Aksan, 2004), thus understanding how dynamic processes are driven by parent versus child may help to illuminate their effects. Understanding parent moderators is also important because emotion socialization actions may not always align with parents' stated values (Eisenberg et al., 1998b). Emotion socialization-related actions may even do harm, and thus a focus on differences in dynamic, dyadic emotion socialization processes that contribute to developmental psychopathology is also important. Additionally, a focus on dyadic processes of emotion socialization over developmental time, in addition to those within-time or within-task, remains an important focus for research: bidirectional (Kuczynski, 2003) and transactional (Sameroff & MacKenzie, 2003) processes have been shown to shape children's emotion-related outcomes at multiple stages of development (Kim et al., 2001). These foci can allow us a more comprehensive and ecologically valid model of emotion socialization informed by developmental psychopathology and dynamic systems principles with which to better understand children's typical and atypical socioemotional development.

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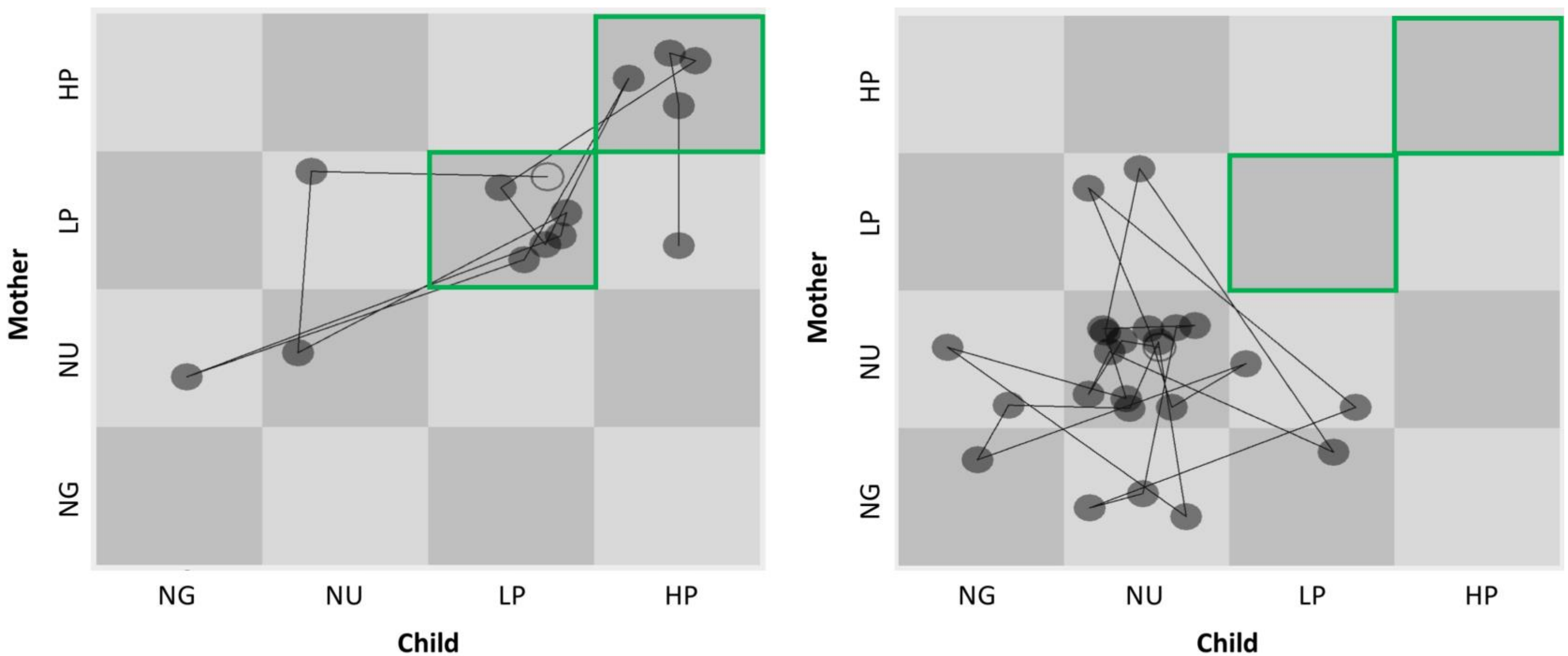
Table 1

Descriptive Data and Correlations

	1	2	3	4	5	6	7	8	9	10	*N*	*M*	*SD*
1. Mother emotional responsiveness	1										229	2.79	.759
2. Mother emotional expressiveness	.536***	1									231	1.59	.382
3. Dyadic positive synchrony - mothers	.352***	.427***	1								220	1.87	2.32
4. Child negative emotional arousal with mother	.007	.147*	-.074	1							224	1.25	.481
5. Father emotional responsiveness	.204*	-.021	.105	-.295**	1						117	2.45	.856
6. Father emotional expressiveness	.171^	.057	.055	-.237*	.633***	1					117	1.44	.269
7. Dyadic positive synchrony - fathers	.211*	.075	.111	-.086	.452***	.513***	1				117	1.98	2.16
8. Child negative emotional arousal with father	.001	.088	-.129	.239*	-.093	-.058	-.074	1			118	1.22	.525
9. Child aggression in preschool	-.109	-.064	-.097	.076	-.084	.019	.040	.211*	1		187	5.30	7.30
10. Child aggression in kindergarten	-.162*	-.104	-.171*	.076	-.103	.015	-.139	.277**	.441***	1	190	3.62	6.82

^$p < .10$ *$p < .05$ **$p < .01$ ***$p < .001$



(a) (b)

Figure 1. Sample State Space Grids illustrating (a) high and (b) low dyadic positive synchrony derived from the proportion of time the dyad spent in the matched low positive and high positive cells outlined in the grid. Note: NG = negative; NU = neutral; LP = low positive; HP = high positive

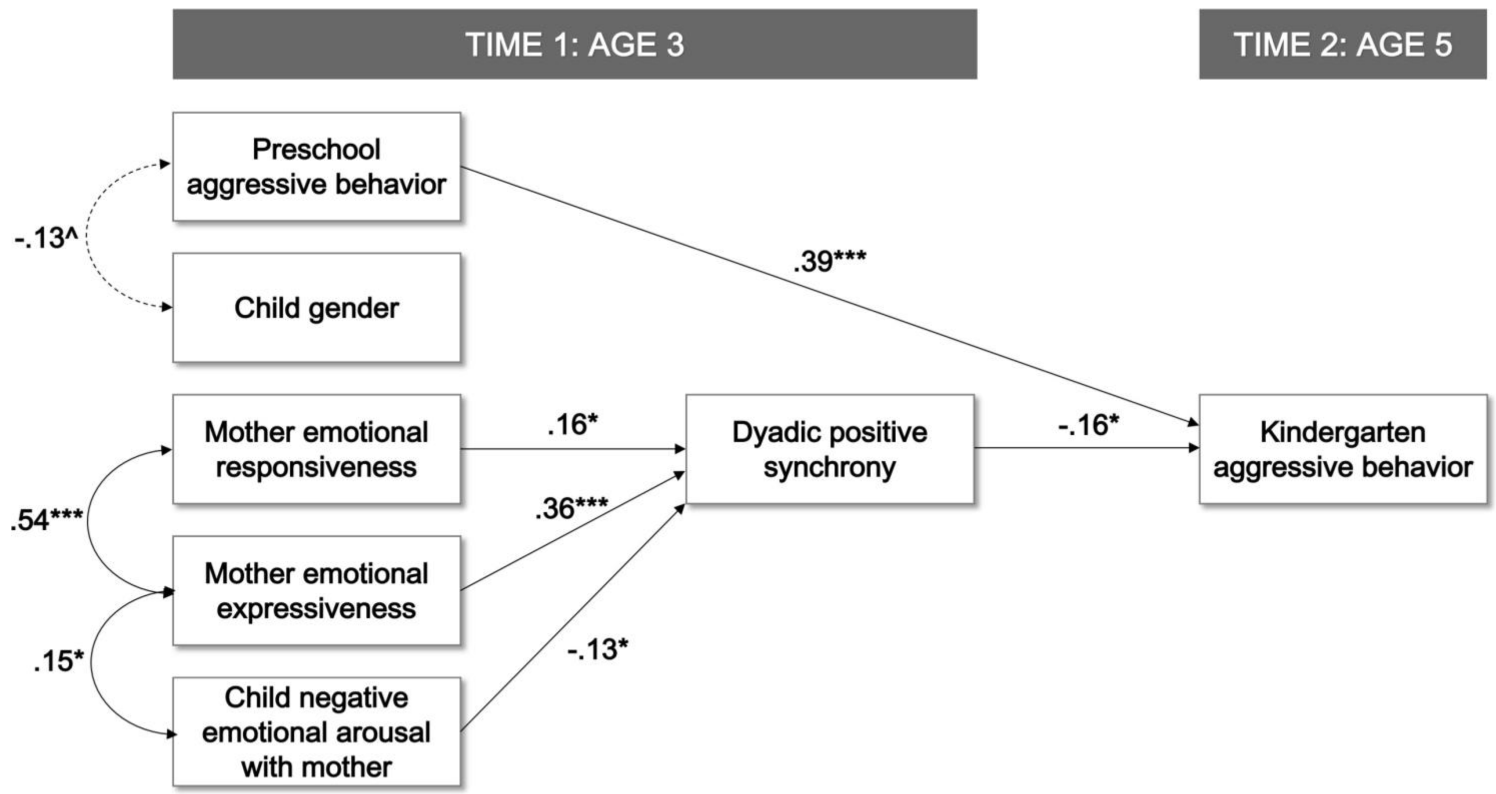


Figure 2. Indirect effects of dyadic positive synchrony in mother-child interactions. ^$p < .10$ *$p < .05$ **$p < .01$ ***$p < .001$

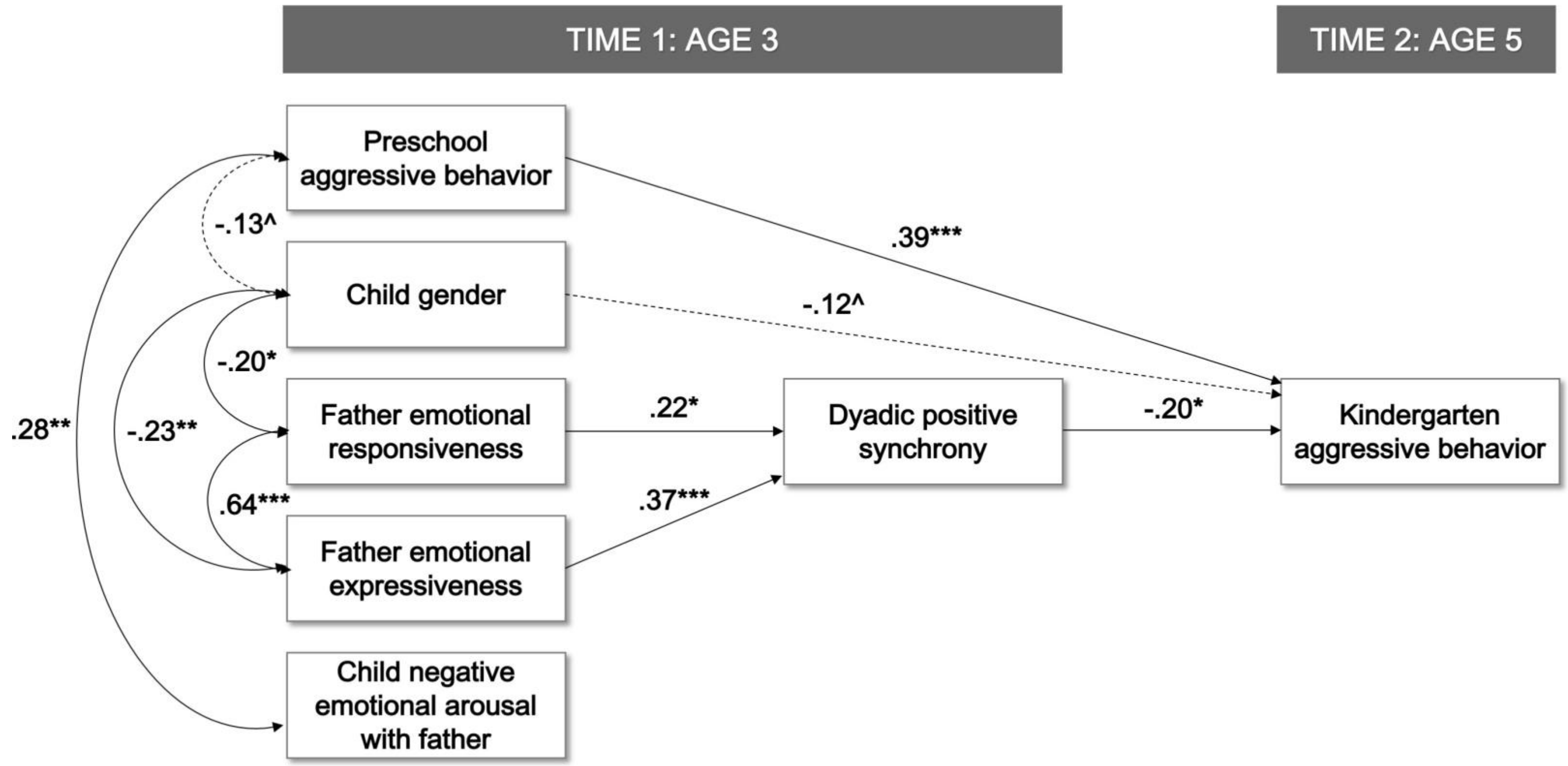


Figure 3. Indirect effects of dyadic positive synchrony in father-child interactions. ^$p < .10$ *$p < .05$ **$p < .01$ ***$p < .001$