



Explicating Child-Driven Patterns of Parent-Child Responsivity in Fragile Families: A Longitudinal Approach

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It has been well-established that development occurs in the context of a transactional framework, with bidirectional parent-child interactions influencing both proximal and distal outcomes. In particular, child vocabulary development is sensitive to parenting qualities including warmth, sensitivity, and control as well as parental stimulation including language input and access to learning enrichment activities. Similarly, these parenting qualities are influenced by and influence children's development of pro-social behaviors. Given the foundational role of both language and pro-social skills for academic achievement and the establishment of healthy relationships across the lifespan, a comprehensive understanding of the magnitude, stability, and reciprocity of such interactions across childhood has the potential to better inform early intervention and prevention practices and highlight risk and resilience factors. This study investigated the concurrent and successive transactional relationships between child pro-social behavior, child emergent language, and parenting qualities within a large, longitudinal sample. This study utilized Waves 3, 4, and 5 of the Fragile Families and Child Well Being Study (FFCWBS), corresponding to focal child age 3, 5, and 9 years, respectively. A series of Structural Equation Modeling (SEM) with full-information likelihood (FIML) estimation ($n = 3,422$) including child prosocial behavior, receptive vocabulary, and supportive parenting behaviors was tested and compared. Our findings indicate significant, positive associations over time between child pro-social behavior and receptive vocabulary, and parenting quality across all three stages of early child development. The steady decline in magnitude of these associations over time highlights the importance of synergistic parent-child interactions in toddlerhood as an early opportunity to propel these developmental outcomes and supportive parenting behaviors. Patterns of change in child pro-social behavior skills and parenting qualities remained positive and relatively stable, while observed growth in child receptive vocabulary skills increased in magnitude over time. Additional investigation of indirect effects specified the role of receptive vocabulary, as well as the bolstering role of prosocial behavior, in eliciting responsive parenting qualities over time.

Keywords: child-driven effects, pro-social behavior, receptive language, parenting qualities, longitudinal, Fragile Families

INTRODUCTION

Early and middle childhood are crucial periods of growth in a variety of cognitive and social-emotional domains. Across child development, pro-social behavior and child language remain relatively stable over time (1–4). And, while both of these skills are fostered early in the context of parent-child interactions, acquisition of these skills also paves the way for children to further develop and refine these skills while socializing with peers. Parenting styles and behaviors also remain relatively stable and influence how children communicate with others and navigate social situations (5, 6). In the transition from early childhood to middle childhood, children become more independent and interact with others more frequently in a variety of social contexts (7, 8). Further, child characteristics such as temperament and emotion regulation can shape patterns of parental responsivity (9–12). The transactional nature of parent-child relationships has been well-established, particularly within the early and middle childhood periods.

Children are at higher risk for a variety of detrimental short-term and long-term outcomes including poor language skills at school entry, more severe behavior problems, and greater difficulty with social competence when raised in families facing socioeconomic adversity (13–15). These risks are exacerbated by differences in parent-child interaction characteristics as parents raising a child in poverty are more susceptible to stress, depression, discrimination, violence, and trauma, which can impede parent responsivity and sensitivity to their children (16, 17). And, parents from low-income backgrounds generally spend less time engaging with their children through cognitive stimulation opportunities at home such as playing and reading together (18–20). Further, reduced opportunities for social-emotional learning and positive engagement at home intensify the developmental risks associated with poverty status, while more frequent reciprocal engagement routines can actually provide buffering effects (21–23).

Given the important role of both pro-social skills and language for life course pathways, knowledge of the magnitude, stability, and reciprocity of parent-child interactions across childhood for children at risk due to poverty status (e.g., “fragile” families) may contribute to more efficient early intervention and prevention practices and enhanced understanding of risk and resilience factors. Thus, this study investigated the concurrent and successive transactional associations between child pro-social behavior, and child receptive language, and supportive parenting across early and middle childhood.

Parallels Between Child Pro-social Behavior and Receptive Language

For most children, spoken language production begins close to the first birthday (24, 25). And, during toddlerhood many children begin to produce word combinations and a rapid period of growth in spoken language production and processing occurs as children approach preschool age (26, 27). Similarly, pro-social skills such as the inclination to help others emerge during toddlerhood and become routine behaviors as children develop social competence (28, 29). Thus, early social behavior

and language skills are intertwined, and both are vital for the transition to primary school and subsequently middle childhood (30–32).

Difficulty with either skill, and in particular difficulty with both skills, contributes to behavior problems which can lead to poor development of friendships and struggles with peer acceptance (6, 33). Routine synchronous social exchanges with parents, teachers, and peers provide opportunities to hone other crucial skills like self-regulation and problem-solving (10, 34, 35). And, for children experiencing socioeconomic disadvantage, social skill strengths have been identified as a mediator in the association between language difficulties and behavioral problems (36). Both pro-social behavior and language skills are predictive of later academic achievement outcomes, thereby influencing attainment of higher education goals, as well as development of stable romantic relationships in young adulthood (37, 38). That is, these skills combined play a pivotal role in positive life course trajectories.

The Influential Role of Parenting Behavior Qualities in Child Development

Parenting behavior plays an instrumental role in shaping both child social competence and language development. When children approach preschool age, social skills and language become more reciprocal and integrated; more socially competent children engage in more language exchange opportunities while children who have received limited language input at home from caregivers will engage in fewer social interactions, thereby experiencing fewer opportunities to improve social competence (1, 39). For instance, Bratsch-Hines et al. (40) evaluated this pathway longitudinally: more positive parent-child verbal interactions contributed to stronger language skills at child age 3 years as well as stronger child social skills in kindergarten. While Barnett et al. (1) identified similar associations between sensitive, positive parenting, language gains, and social competence gains during toddlerhood, most work to date has focused on growth in either language (41, 42) or social competence (43, 44), not both child development outcomes. Additionally, language gains have also been observed in low-income samples when sensitive parenting and positive parent-child interactions are an early intervention target (34, 45). And, adverse outcomes including child aggression and disordered language disorders have been observed when harsh parenting strategies including spanking are utilized (33, 43). Previous work has noted parenting behaviors and parenting stress as two of the most prominent contributing factors for child development outcomes, and when parents are raising families in the context of poverty they are more likely to be exposed to stressors such as neighborhood-related fear (46, 47). These family-level socioeconomic risk factors can contribute to adverse parent practices, but these risk effects may be mitigated with supportive parenting practices such as maternal warmth and parental monitoring (48, 49).

Among the specific parenting behaviors linked to both child social skills and language growth, supportive and responsive parenting has continued to gain empirical ground. For instance, a large-scale study ($n = 1,364$) investigated the stability

of parenting behaviors across early development (e.g., child age 0–6 years), adverse parenting behaviors like hostility and negative regard were not regularly noted over time while parenting qualities like sensitivity, supportiveness, and stimulation were highly stable over this period (50). Additional evidence has confirmed stability of sensitive parenting practices, primarily focused on parenting practices during infancy and toddlerhood (1, 51). Also labeled facilitative parenting, parenting characterized by warmth and sensitivity has been found to contribute to child pro-social behavior (52, 53), above and beyond dysfunctional parenting (54). Supportive and responsive parenting behaviors have also been established as facilitators of cognitive growth (55), particularly language growth (56, 57). To date, however, studies focused on describing patterns of change in parenting behaviors, child social skills, and child language are often limited to changes within a specific developmental period such as infancy or late childhood; rarely have studies investigated these associations with a large, nationally representative sample across multiple child development stages.

Reciprocal Patterns in Parent-Child Engagement

While parenting behaviors shape child behavior, children also elicit changes in parental wellbeing and responsivity; these child-driven effects are especially prevalent during developmental transition periods such as toddlerhood (58) and middle childhood (59, 60). Reciprocal associations are evident across child development but shifts in magnitude and direction of effects occur in these transition periods (10, 61). For instance, early parenting practices like warmth shape child cognitive schemas, and lack of parental warmth has been linked to child to parent aggression transmission (62). As parents provide developmental support, they also react to individual child characteristics such as temperament, intelligibility, attentional focus, activity level, and personality (63, 64), and this transactional feedback loop continues as children subsequently react to parent behaviors (65). Child characteristics and behavior may also influence parent stress levels, potentially exacerbating stress parents are already experiencing due to environmental risk factors (i.e., single parent status, financial insecurity, and depression) and eliciting shifts or fluctuations in parenting style (66, 67). Upon evaluation of reciprocal relations between positive parenting and child pro-social behavior in a large global study, higher levels of child pro-social behavior in late childhood elicited greater subsequent parental warmth and involvement while reciprocal relations in the inverse direction were non-significant (68). Additional studies that have evaluated reciprocal parent-child relations across more broad developmental periods (e.g., child age 2–7 and 8–13 years) have specifically identified child-driven effects, such that child behavioral patterns have enacted a robust and sustained influence on parenting practices (69, 70). But, much of the empirical work to date has focused on the reciprocal relations between negative parenting practices and adverse child outcomes [e.g., (71, 72)]. Thus, further investigation of reciprocal effects specific to parenting practices and child factors that

interact synergistically throughout the transition from early to late childhood is needed.

Current Study

The present study utilized data from the Fragile Families and Child Wellbeing Study (FFCWS) to investigate developmental trajectories of child pro-social skills and receptive vocabulary, as well as supportive parenting, with FFCWS sample data from Waves 3, 4, and 5 which reflect child ages 3, 5, and 9 years, respectively. The aims of this study included the following: (1) to evaluate the stability of child pro-social skills, receptive vocabulary abilities, and supportive parenting across children ages 3–9 years; and (2) to investigate the transactional nature of concurrent and longitudinal associations of the aforementioned variables by comparing a cross-lagged model, parent effects model, and child-driven model. A parent effects model includes significant pathways from supportive parenting to child pro-social behavior and child receptive language over time, with non-significant pathways from child measures to supportive parenting. In contrast, a child-driven model includes significant paths from child measures to subsequent supportive parenting, and non-significant paths from supportive parenting to later child outcomes. Based on these models, we anticipated a relatively stable increasing pattern of child pro-social skills and child receptive language over time as well as stability in supportive parenting. Further, we expected to observe robust transactional effects for these associations as evidenced by the cross-lagged model better fitting the data in comparison to the parent effects model and the child-driven model. This study extends previous empirical work by examining the concurrent and successive reciprocal associations between child development and supportive parenting within a longitudinal framework, specifically focusing on synergistic child and parent behaviors that can be promoted through intervention. Additionally, the current study advances the current literature base by utilizing data from a large nationally representative sample, measured across multiple child development stages and transitions.

METHODS

Data Source and Sample

This study used data from the FFCWS, a large population-based birth cohort longitudinal project which followed families from pregnancy through 15 years of age in 20 large United States cities (73) and oversampled children from low-income families and neighborhoods, as well as children born to single mothers from 1998 to 2000. Families were recruited from hospitals and they were interviewed immediately following the focal child's birth (i.e., wave 1, baseline). The present study included families in 18 cities ($n = 4,374$), excluding FFCWS participants in two cities where the pilot study was carried out and thus measurement administration varied initially. The average age of primary caregivers at baseline was 25.29 ($SD = 6.05$) ranging from 15 to 43 years. The FFCWS followed up with all families when the focal child (boys = 2,276; 52%) was ~1, 3, 5, and 9 years old (i.e., waves 2–5). Participants self-reported mother race (30%

White, 51.3% Black or African-American, 2.7% Asian or Pacific Islander, 2.6% American Indian, Eskimo, or Aleut, and 13.5% Other, not specified) and ethnicity (21.7% White, non-Hispanic, 49% Black, non-Hispanic, 25.2% Hispanic, and 3.9% Other). The current study utilized a series of data measures collected through telephone interviews, in-home interviews with a primary caregiver, and in-home observations of family factors as well as child behavior.

Measures

Pro-social Behaviors

Children's pro-social behaviors were assessed using the *Adaptive Social Behavior Inventory* [ASBI; (74)] at ages 3, 4, and 9 years, based on interviews completed over the phone or in-person with primary caregivers. The measure evaluates children's social competence using two subscales of positive social engagement behavior, Express and Comply, based on a 3-point scale (0 = not true to 2 = very or often true). The FFCWS utilized nine items for 3-year study, and 13 items for 5-year and 9-year study after adaptation. In the current study, we created latent variables that consistently reflect children's prosocial behaviors within each wave by applying a cut-off threshold of factor loading below 0.50 to the measurement model and below 0.175 to the correlation matrix including all items, resulting in seven items, 11 items, and 13 items for each wave. Cronbach's α s indicated 0.69, 0.80, and 0.91 at each year, respectively.

Receptive Vocabulary

Children's receptive vocabulary was evaluated using standard scores from the *Peabody Picture Vocabulary Test, Third Edition* [PPVT-3; (75)] with children at 3, 5, and 9 years of age. In-home administration procedures included the interviewer reading a word aloud and asking the child to indicate which picture best corresponded to the word from a set of four pictures choices on an easel.

Supportive Parenting

Supportive parenting was measured with the *Home Observation for Measurement of the Environment* [HOME; (76)] at 3, 5, and 9 years of age. Trained interviewers assessed supportive parenting behaviors through in-home observations while primary caregivers were interacting with their children. The FFCWS used nine items for wave 3 of the study, eight items for wave 4 of the study, and seven items for wave 5 of the study which were all selected from the original HOME scale. Each item was scored as a binary variable (0 = no or 1 = yes) with higher values indicating more parental responsivity and warmth. Some scale items were included in Waves 3–5 (e.g., parent's voice conveyed positive feelings), however most scale items differed slightly across waves based on child age. For instance, in Wave 3 the observer reported on whether the parent told the name of an object or person and whether the parent kissed or caressed the child, while in Wave 4–5 the observer reported on whether the parent encouraged the child to contribute to conversation and whether the parent helped the child demonstrate an achievement or skill. In this study, we created latent variables that reliably reflect supportive parenting behaviors within each wave by

applying a cut-off threshold of factor loadings below 0.50 to the measurement model and below 0.175 to the correlation matrix of all items, resulting in eight items, seven items, and six items for waves 3, 4, and 5, respectively. Cronbach's α s indicated 0.80, 0.79, and 0.73 at each corresponding wave.

Covariates

Given the sample's heterogeneity in risk factors, we additionally controlled for early contextual factors such as child gender and family risk factors measured at baseline (i.e., lack of annual income earned, single parent status, low education, and severe depression) while examining the stability and magnitude of effects observed for these developmental trajectories. A cumulative family risk perspective has been established as an effective strategy for describing the accumulation of numerous risk factors as related to children's maladjustment, rather than presence of a single risk factor (77, 78). Researchers have tried to identify the influence of concurrent, cumulative risk factors by utilizing cumulative risk models wherein a cumulative risk index is calculated by summing each item dichotomized as presence on a value of 1 or absence on a value of 0 (79). Accordingly, the present study considered three variables that may influence observed effects between variables of interest (i.e., child pro-social behavior and receptive vocabulary and supportive parenting). These covarying variables included the following: child gender, mother race, and an index of family risk factors. The family risk index variable was constructed by tallying and summing four indicators (0 = no or 1 = yes) such as no earnings in the past year (70%), single parenthood (41%), <12 years of schooling (33%), and meeting depression criteria (20%) [see (80)].

Analytical Strategies

The current study conducted a series of Structural Equation Modeling (SEM) tests using Mplus Version 8 (81) with full-information maximum likelihood (FIML) estimation. Specifically, a cross-lagged panel design model was assessed to examine bidirectional effects between child development (i.e., pro-social skills and receptive vocabulary) and supportive parenting. Individual models were evaluated and compared until the best-fitting, most parsimonious model was determined using Chi-square difference tests. The following four criteria were used as model fit indices: (1) the comparative fit index (CFI), (2) the Tucker–Lewis index (TLI), (3) the root mean square error of approximation (RMSEA), and (4) the standardized root mean square residual (SRMR). While CFI and TLI values of over 0.90 and 0.95 suggest a well-specified model, RMSEA and SRMR values close to or lower than 0.08 or indicate acceptable and excellent fit between the model and the dataset (82, 83).

To investigate the primary aims of this study, we estimated and compared a series of individual models while controlling for additional circumstantial factors including child gender, maternal race, and family risk factors evaluated at baseline (i.e., lack of annual income earned, single motherhood, low education, and severe depression) until a parsimonious, best fitting model was identified. Accordingly, we investigated three time points when children were 3, 5, and 9 years old using the following

TABLE 1 | Descriptive statistics and Pearson correlations among study variables.

Variables	1	2	3	4	5	6	7	8	9
1. PSB3	1.00								
2. PSB4	0.33***	1.00							
3. PSB5	0.291***	0.313***	1.00						
4. RV3	0.195***	0.199***	0.168***	1.00					
5. RV4	0.178***	0.232***	0.227***	0.504***	1.00				
6. RV5	0.195***	0.185***	0.214***	0.465***	0.624***	1.00			
7. SP3	0.196***	0.171***	0.139***	0.280***	0.208***	0.202***	1.00		
8. SP4	0.091***	0.211***	0.119***	0.157***	0.277***	0.232***	0.190***	1.00	
9. SP5	0.014	0.066**	0.078***	0.049*	0.109***	0.098***	0.101***	0.125***	1.00
	PSB3	PSB4	PSB5	RV3	RV4	RV5	SP3	SP4	SP5
<i>N</i>	2,771	2,828	2,866	2,182	2,235	3,014	1,826	1,987	2,698
<i>M</i>	1.69	1.73	1.47	85.52	92.99	92.87	0.87	0.75	0.74
<i>SD</i>	0.32	0.29	0.44	16.69	15.96	14.68	0.21	0.27	0.27
Range	2.00	2.00	2.00	97	99	115	1.00		
Skew	-1.23	-1.52	-0.98	-0.39	-0.55	0.43	-2.08	-0.93	-0.95

PSB, child pro-social behavior; RV, child receptive vocabulary; SP, supportive parenting, labels of 3, 4, or 5 indicates Fragile Families data wave 3, 4, or 5 corresponding to child age 3, 5, or 9 years, respectively. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

four suggested models: (1) a stability model testing stability of child pro-social behavior, child receptive vocabulary, and supportive parenting, (2) a cross-lagged model testing concurrent and longitudinal associations of child pro-social behavior, child receptive vocabulary, and supportive parenting behaviors over time, (3) a parent-effects model testing how supportive parenting relates to later child pro-social behavior and receptive vocabulary, and (4) a child-driven model testing how child pro-social behavior and receptive vocabulary relate to later supportive parenting behaviors.

Missing Data

The FIML approach is a useful missing data estimation method which calculates unbiased parameter estimates and standard errors. This method provides parameter estimates while maximizing the likelihood of the underlying distributions of incomplete data with missingness so that all the information available is fully used (84). Group comparison tests were conducted to see if there were differences in demographics between the original sample from 18 cities ($n = 4,374$) and the remaining sample in the FFCWS project until Wave 5 ($n = 2,925$). Family information, including child gender, maternal age, maternal race, maternal education, and family income measured at baseline, was examined using independent samples t -tests. There were no significant differences in child gender, $t_{(7,296)} = 0.44$, $p = 0.66$, mother's age, $t_{(7,292)} = 1.44$, $p = 0.15$, and maternal race, $t_{(7,170)} = -0.93$, $p = 0.35$, between the two groups. There were differences in maternal education and family income such that the remaining sample was more likely to have higher education, $t_{(7,290)} = 3.38$, $p = 0.001$, and greater household income, $t_{(7,296)} = 3.86$, $p < 0.001$, compared to the original sample. Low maternal education level and poverty were included as covariates for all models tested in the current study.

RESULTS

Stability and Cross-Lagged Models

Simultaneous and prospective associations among child pro-social behaviors, receptive vocabulary, and supportive parenting at child ages 3, 5, and 9 years, were evaluated with stability and cross-lagged models, then compared to each other using chi-square difference tests. Descriptive statistics and effect sizes for all associations across constructs are shown in **Table 1**. The model fit indices indicated CFI = 0.89, TLI = 0.88, RMSEA = 0.03, SRMR = 0.04 for the stability and cross-lagged models. Comparison of the stability and cross-lagged models yielded a change in χ^2 of 77.30 ($p < 0.001$) with a difference of 4 degrees of freedom such that the additional free parameters in the cross-lagged model provided a better fit than the stability model (see **Table 2**). Therefore, the cross-lagged model was selected as the better fitting model. Favoring the cross-lagged model to the stability model suggested that the three constructs in the proposed model influenced each other over time.

In the cross-lagged model, child pro-social behavior at age 3 and 5 years, $\beta = 0.41$, $p < 0.001$, and at 5 and 9 years, $\beta = 0.33$, $p < 0.001$, was positively correlated. Child receptive vocabulary at age 3 and 5 years, $\beta = 0.47$, $p < 0.001$, and that of children age 5 and 9 years, $\beta = 0.61$, $p < 0.001$, was also positively correlated. Supportive parenting at child age 3 and 5 years, $\beta = 0.20$, $p < 0.001$, and that of child 5 and 9 years, $\beta = 0.18$, $p < 0.001$, was positively correlated. At child age 3 years, pro-social behavior was positively related to receptive vocabulary, $\beta = 0.22$, $p < 0.001$, and to supportive parenting, $\beta = 0.30$, $p < 0.001$, and receptive vocabulary was positively associated with supportive parenting, $\beta = 0.24$, $p < 0.001$. At child age 5 years, pro-social behavior was positively related to receptive vocabulary, $\beta = 0.10$, $p < 0.001$, and to supportive parenting, $\beta = 0.21$, $p < 0.001$, and receptive vocabulary was positively associated with supportive parenting,

TABLE 2 | Chi square difference test across nested models of child prosocial behavior, receptive language, and supportive parenting.

Model	χ^2 -test				Change in χ^2 -test		
	χ^2	df	χ^2 /df	<i>p</i>	χ^2	df	<i>p</i>
1. Stability	5,981.05	1,556	3.84	<0.001			
2. Cross-lagged	5,903.76	1,552	3.80	<0.001			
3. Stability vs. cross-lagged					77.30	4	<0.001
4. Parent effects	5,897.45	1,548	3.81	<0.001			
5. Cross-lagged vs. parent effects					6.31	4	0.178
6. Child-driven	5,871.89	1,544	3.8	<0.001			
7. Cross-lagged vs. child-driven					31.87	8	<0.001
8. Child-driven (trimmed)	5,880.65	1,550	3.8	<0.001			

N = 3,382. Model fit indices for all models include CFI = 0.89, TLI = 0.88, RMSEA = 0.03, SRMR = 0.04.

$\beta = 0.25$, $p < 0.001$. At age 9 years, pro-social behavior was positively related to receptive vocabulary, $\beta = 0.06$, $p = 0.013$, and to supportive parenting, $\beta = 0.11$, $p < 0.001$, and receptive vocabulary was positively associated with supportive parenting, $\beta = 0.06$, $p = 0.012$. Pro-social behavior of children at 3 years of age was positively linked to receptive vocabulary of 5 years, $\beta = 0.11$, $p < 0.001$, pro-social behavior at 5 years of age, and receptive vocabulary at age 9 years, $\beta = 0.05$, $p = 0.007$. Receptive vocabulary of 3-year-old children was positively linked to pro-social behavior of children at age 5 years, $\beta = 0.13$, $p < 0.001$, and receptive vocabulary at age 5 years was associated with pro-social behavior at age 9-years, $\beta = 0.06$, $p = 0.012$.

Parent Effects Model

Next, a parent effects model was tested to assess how supportive parenting behaviors are related to child pro-social behavior and receptive vocabulary over time, while taking into account the stability of each factor. The model fit indices of the parent effects model were CFI = 0.89, TLI = 0.88, RMSEA = 0.03, SRMR = 0.04. Comparison of the cross-lagged and parent effects models indicated that the cross-lagged model was a better fitting model, $\Delta\chi^2(4) = 6.31$ (n.s.) such that supportive parenting behaviors were not significantly altering the patterns of later child pro-social behavior or receptive vocabulary. Rather, the model including associations between supportive parenting behaviors and child outcomes over time more precisely described observed patterns of change between *all* of the individual data points in the sample. The parent effects model, which omitted paths signifying correlations between child outcomes and subsequent parenting behaviors, did not yield a more accurate depiction of the observed associations between these constructs.

Child-Driven Model

A child-driven model was tested to identify whether patterns of child pro-social behavior and receptive vocabulary related to later supportive parenting, while taking into account the stability of each factor. The model fit indices in the child-driven model were CFI = 0.89, TLI = 0.88, RMSEA = 0.03, SRMR = 0.04. Results of comparing the cross-lagged and child-driven models showed a change in χ^2 of 31.87 ($p < 0.001$) with a difference of 8 degrees of freedom, such that the additional free

parameters in the child-driven model provided a better fit than the cross-lagged model. Favoring the child-driven model to the cross-lagged indicated that early child development, including pro-social behavior and receptive vocabulary, was related to later supportive parenting. The child-driven model was selected as the most parsimonious, better fitting model and was then trimmed based on significance levels ($p < 0.05$) of standardized parameter estimates of direct effects. The trimmed child-driven model did not show a significant decline in the model fit value, $\Delta\chi^2(6) = 8.76$ (n.s.), and was selected as the best model with model fit indices, CFI = 0.89, TLI = 0.88, RMSEA = 0.03, SRMR = 0.04. **Figure 1** shows standardized path coefficients; the significant standardized coefficients ranged from 0.047 to 0.612, p -values ranged from <0.000 to 0.047. The 95% lower and upper limits of bias-corrected bootstrap confidence intervals (95% BC CIs) did not include zero; for example, 95% CI [0.574, 0.653] for $\beta = 0.612$ and 95% CI [0.003, 0.091] for $\beta = 0.053$.

Models by Maternal Race and Child Gender

To identify potential conditional associations in the child-driven model, maternal race and child gender were further evaluated as grouping variables. When maternal race was incorporated as a grouping variable with child gender and family risk as control variables, the model failed to converge. In the final child-driven model selected, maternal race was only significant in relation to child prosocial behavior at age 5 years and supportive parenting at child age 9 years ($\beta = -0.07$, $p < 0.001$). Inclusion of maternal race in all models did not yield meaningful differences in model fit or parameter estimations. Therefore, race was not found to be an influential factor in our study.

Then, a model with child gender as a grouping variable was estimated to probe gender differences and gauge next steps for multi-group investigations. In contrast to our non-significant findings for race, child gender contributed to differences in parameter estimation and model fit, $\chi^2(3,100) = 7,833.89$ ($p < 0.001$), CFI = 0.88, TLI = 0.87, RMSEA = 0.03, SRMR = 0.04. In the final child-driven model selected, child gender was significant in relation to child prosocial behavior at all waves (in increasing wave order: $\beta = 0.06$, $p = 0.01$; $\beta = 0.05$, $p = 0.03$; $\beta = 0.04$, $p = 0.04$), child receptive language at all waves ($\beta = 0.05$, $p = 0.01$; $\beta = 0.04$, $p = 0.03$; $\beta = -0.08$; $\beta = 0.04$, $p < 0.001$), and supportive

Trimmed Child-Driven Structural Path Model Across Child Age 3-9 Years

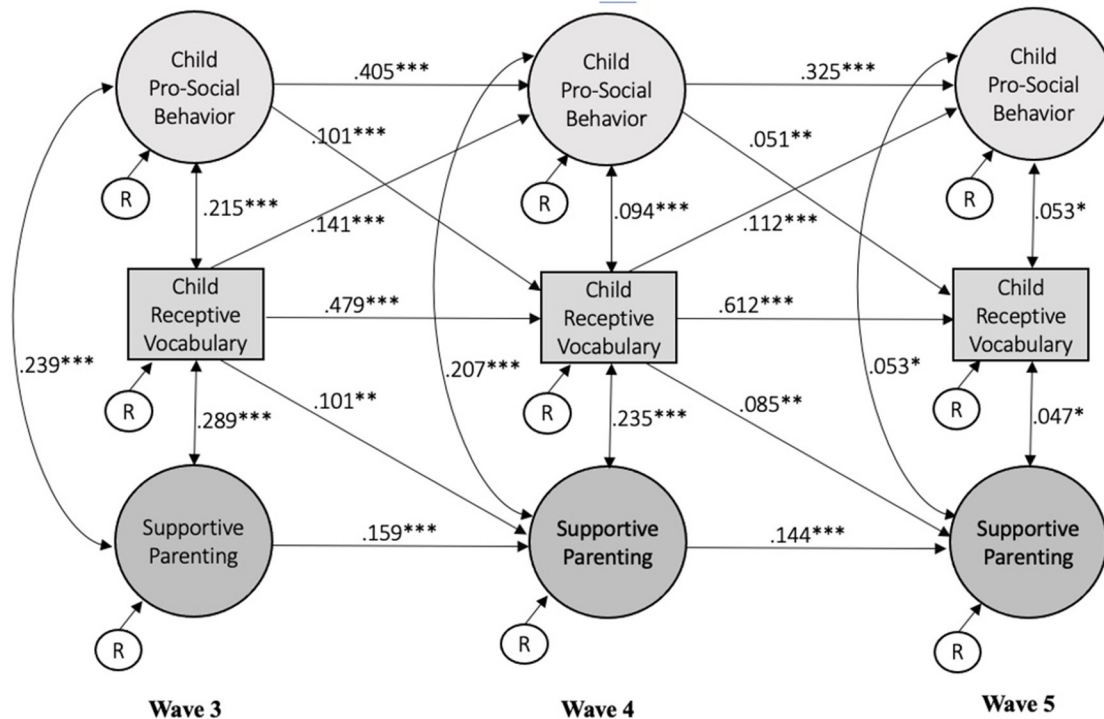


FIGURE 1 | Trimmed child-driven structural path model across child age 3–9 years. Focal child ages are 3, 5, and 9 years at wave 3, 4, and 5, respectively. Model controlled for child gender, mother's race, and family risk at baseline. Stability and cross-lagged models include only child pro-social behavior and receptive vocabulary. Standardized coefficients presented. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

parenting only at child age 5 years ($\beta = 0.06$, $p = 0.02$). See **Figures 2, 3** for standardized parameter estimations specific to males and females, respectively. The 95% CIs did not include zero; for instance, 95% CI [0.537, 0.661] for $\beta = 0.608$ and 95% CI [0.002, 0.176] for $\beta = 0.087$ in the males only child-driven model, and 95% CI [0.580, 0.665] for $\beta = 0.623$ and 95% CI [0.010, 0.147] for $\beta = 0.077$ in the females only child-driven model.

In the males only child-driven model, the concurrent correlations in association between child pro-social behavior and receptive vocabulary were non-significant at age 5 and 9 years. Additionally, the association between males' pro-social behavior and supportive parenting at age 9 years was also non-significant. In the females only model, child-driven effects observed were limited to child pro-social behavior; that is, receptive vocabulary at child age 3 and 5 years was not significantly associated with supportive parenting at child age 5 and 9 years, respectively. The concurrent association between females' pro-social behavior at age 5 years and receptive vocabulary at age 9 years was also non-significant. With incorporation of the grouping variable, both males and females only models no longer indicated a significant relation between receptive child vocabulary and supportive parenting at age 9 years.

DISCUSSION

This study provides novel evidence and insight regarding early parent-child dynamics and associated patterns in child development for children from at-risk, or fragile, families. Specifically, these findings contribute support for a child-driven model to best explain the reciprocal associations between child pro-social skills, child receptive language, and supportive parenting. In the final model, autoregressive paths for both child development dimensions of interest, receptive language and pro-social skills, remained significant across all child ages measured. The autoregressive paths for supportive parenting also remained significant over time. Associations between child development measures and later supportive parenting behaviors were consistently found to be significant across waves, however the associations between supportive parenting and later child development measures were non-significant, hence confirmation of the proposed child-driven effects model. Upon evaluation of differences in estimated model parameters and significant paths attributed to child gender, the relation between concurrent pro-social behavior and receptive vocabulary was non-significant for boys at age 5 and 9 years. And, group differences indicated girls' receptive vocabulary skills, unlike pro-social behavior,

Trimmed Child-Driven Structural Path Model Across Child Age 3-9 Years, Males Only

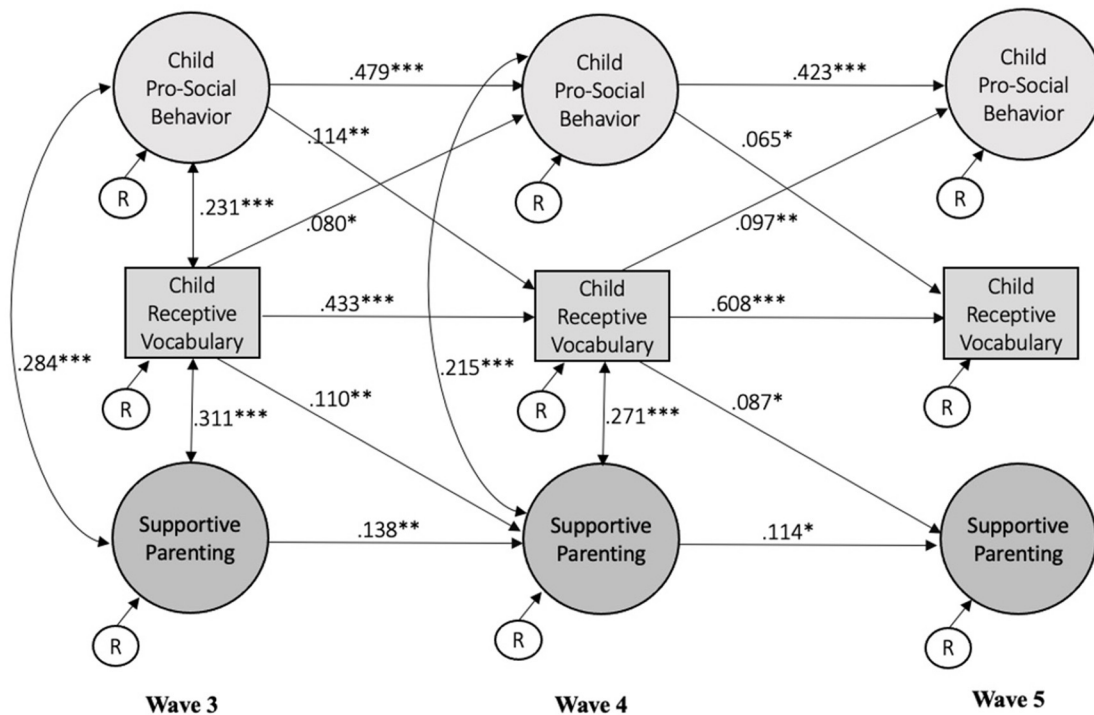


FIGURE 2 | Trimmed child-driven structural path model across child age 3–9 years, males only. Focal child ages are 3, 5, and 9 years at wave 3, 4, and 5, respectively. Model controlled for child gender, mother's race, and family risk at baseline. Standardized coefficients presented. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

were not associated with changes in supportive parenting over time. This investigation builds upon prior studies that have investigated child development outcomes utilizing a dynamic systems approach (1, 34, 85), emphasizing that child skill development in various domains occurs as a result of interactions between internal systems (e.g., child language skills) and external systems (e.g., supportive parenting). By testing a series of SEM models with a large longitudinal dataset from fragile families, our results provide additional compelling support for feedback loops and phase transitions as evidenced by the cross-lagged associations and shifts in association magnitude over time (86, 87). Further, by focusing on a sample of interest based on familial risk this investigation draws targeted attention to intervention approach considerations warranted including timeliness of parent-driven vs. child-driven parent outcomes.

When comparing within- and across-time models of relations between child pro-social behavior, child receptive language, supportive parenting with and without cross-lagged effects accounted for, we confirmed change in both child and parent factors of interest over time shifted collectively as modeled in the cross-lagged model rather than independently as modeled in the stability model. That is, social skill development and early child language do not occur in a continuous vacuum, and early parenting behaviors fluctuate as well. Patterns of correlation for child pro-social behavior were stable over time, with the strongest

change in association magnitude observed in the transition from age 3 to 5 years. This is consistent with prior empirical evidence emphasizing the pre-school to primary school transition period as a crucial window of time for honing early social skills (31, 88). Similarly, patterns of correlation for child receptive vocabulary also remained stable over time, although the strongest association was observed for the transition for children from age 5 to 9 years. Again, this finding is corroborated by prior research identifying the early to middle childhood period as a distinct phase of receptive vocabulary development and important period for intervention (89, 90). As expected, the magnitude of association between child pro-social behavior and child receptive vocabulary remained relatively consistent over time.

While we anticipated the reciprocal parent-child factor associations, subsequent model comparisons indicated that not only did supportive parenting behaviors fluctuate with these child factors—supportive parenting fluctuated based on association with the child factors as evidenced by the child-driven model better fitting the data than the transactional model and the parent-driven effects model. This finding suggests that targeting early child developmental skills such as social behavior and language skills in a variety of learning environments (e.g., home, preschool or daycare, and primary school) has the potential to elicit positive, indirect effects on supportive parenting over time. Notably, prior research has identified attentional and

Trimmed Child-Driven Structural Path Model Across Child Age 3-9 Years, Females Only

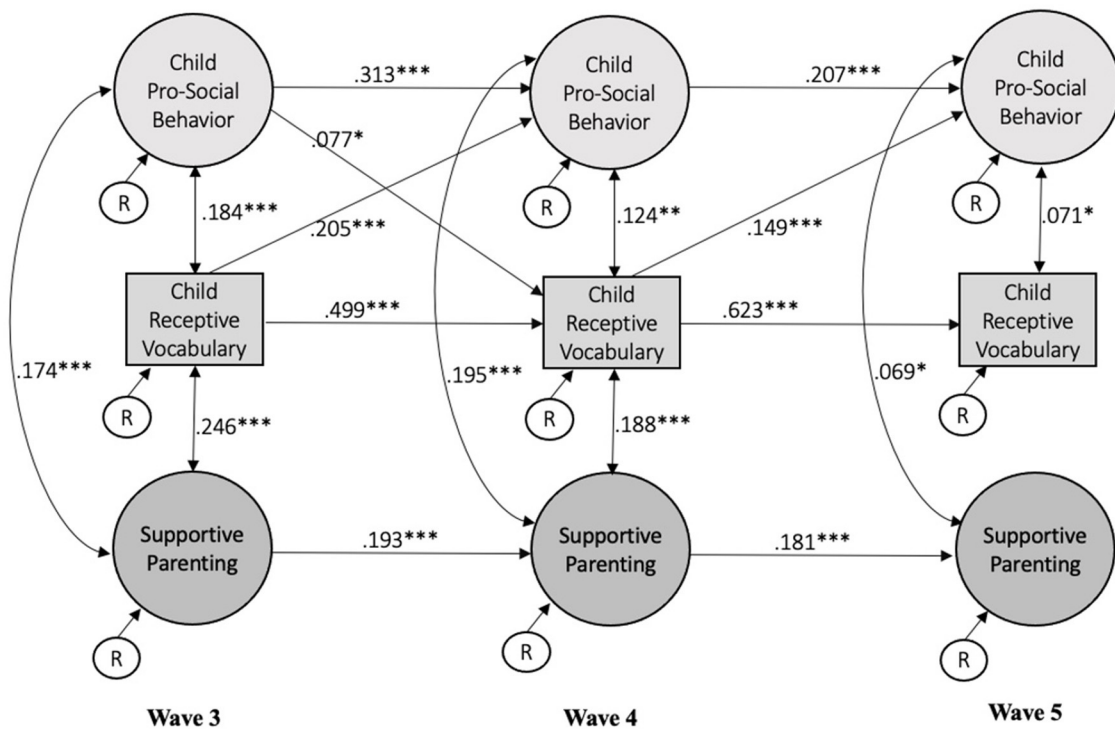


FIGURE 3 | Trimmed child-driven structural path model across child age 3–9 years, females only. Focal child ages are 3, 5, and 9 years at wave 3, 4, and 5, respectively. Model controlled for child gender, mother's race, and family risk at baseline. Standardized coefficients presented. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

emotional regulation as a mechanism of change between early supportive parenting qualities (e.g., warmth, lack of hostility) and later child pro-social behavior (53). Consistent with Healy et al. (54), we assert that parent-child engagement quality and depth of communication may be critical contributing factors for child pro-social skills, above and beyond supportive parenting qualities. We propose that our findings for child-driven effects can be explained by parents reinforcing child early social engagement strengths with facilitative parenting, thus parents and children engage in more frequent and complex social routines when children are effectively regulating their social attention and understanding parent communication. Our results for gender differences were unexpected, however we suggest these findings can be explained by girls' strengths in early pro-social skills compared to boys (91) exacerbating the child-driven effects observed for social skills over time rather than receptive language. Contrary to the findings from Slot et al. (92), the current study found language to be significantly associated with of both boys' and girls' social skills over time. Since that study's measure of social skills was more holistic in comparison to the current study's more precise evaluation of pro-social behavior, we attribute our lack of corroboration with Slot et al. (92) may be due to underlying gender differences in aspects of social-emotional skills including self-regulation and activity level (93, 94).

Given the sample of interest in this study and the added environmental, financial, and emotional stress often experienced by these families, prioritizing child targets can not only bolster internal child outcomes but also elicit buffering effects for the entire family system. Further, the magnitude of concurrent association between supportive parenting and both child pro-social behavior and child receptive vocabulary was observed to be strongest when children are 3 years of age, and concurrent, as well as cross-lagged, correlations declined in strength over time when associations were adjusted for prior achievement status or behavior. That is, these results highlight the necessity of intervention and prevention practices for at-risk children and families as early as possible to optimize these reciprocal and child-driven effects. The loss of significant pathways between concurrent measures of interest at 9 years of age for boys in the current study also suggests that the transactional effects of positive parent-son social engagement routines may be more instrumental for child development outcomes when targeted before beginning primary school. Since parent-driven effects were not observed over time for supportive parenting behaviors specifically including warm and verbally responsive behavior, we also emphasize the need for targeted interventions to include parent coaching on communication quality such as aligning timely verbal responses to child interests in a distraction free environment. Thus, optimal parent-child interaction routines

may utilize previously established mechanisms of growth, such as child emotion and attention regulation, through engaging play activities in addition to conversational dialogue.

Limitations

The present study includes several strengths including utilization of advanced statistical analysis, SEM, with a large longitudinal dataset and a variety of observational as well as parent-reported measures. However, we acknowledge some limitations and provide relevant recommendations for future studies. While the authors selected a cross-lagged panel model based on the goal of evaluating collective patterns over time rather than within-person dynamics, we acknowledge this type of model assumes that model effects are fixed across individuals. It is possible that measurement of between-person variance with a random-intercept model could yield different association patterns. We acknowledge potential unobserved confounds that were not adjusted for, resulting in a weak set of controls. More specifically: while we were able to account for shared measurement variance by including latent factors for child pro-social behavior and supportive parenting, receptive language was incorporated in all models with a single indicator factor based on the language variables measured in the FFCWS. This analysis could have been strengthened with incorporation of additional language measures including parent-report and teacher-report measures. Further, future studies could integrate a more comprehensive assessment of language skills by incorporating expressive language measures, analysis of spontaneous speech samples, and early non-verbal communication assessments (e.g., gesture profiles). The current study focused on receptive language, and not expressive language, based on the standardized measures administered in the FFCWS study at these time points. Additionally, future works utilizing SEM could strive to incorporate latent factors with more rigorous consistency across time points.

While all observed variables for pro-social behavior and supportive parenting in this study were obtained from the same measures at each wave, the ASBI (74) and HOME (76), respectively, and each latent factor was evaluated and modified to fulfill inter-item reliability stipulations, item phrasing and quantity of items administered varies across waves based on child norms expected for various developmental periods. Ruling out potentially confounding item variance introduced by item variability between waves may improve validity and subsequent causality assumptions. Given the nature of some of the HOME items (e.g., reporting of observed physical and verbal reprimand, noting access to learning enrichment materials) observed and the sample of interest, we acknowledge inherent limits to measurement with this tool and recommend caution in both analysis and generalization of results in future works with the HOME scale. Further, while the current study evaluated variability in reciprocal effects specific to child gender and maternal race, we urge future work to utilize a more socioeconomically diverse sample and complete a dynamic examination of reciprocal effects in the context of income disparities. Relatedly, although the effect sizes when child gender was used as a grouping variable cannot be directly compared between the two groups, it was obvious that boys and girls

showed differences in associations between child development and supportive parenting over time. Future studies utilizing a multi-group approach of comparing effect sizes may advance our understanding of specific differences between genders. Based on data attrition and item consistency over time, the current study utilized an additive risk approach and controlled for family risk factors as a time-invariant variable. We suggest that future studies include careful consideration of both time-invariant and time variant demographic variables and family risk items in future work. Lastly, we acknowledge that the current study strived to evaluate supportive parenting behaviors, but our analysis primarily includes data reflecting mothers' parenting behavior based on the FFCWS oversampling children born to unmarried mothers. Evaluating mothers' and fathers' unique contributions [see (95)] to the reciprocal relations of interest in the current study is an area of need for future research.

CONCLUSION

This investigation provides a significant contribution to the current literature examining transactional associations across child development by supporting significant child-driven effects, explaining children have the capability to influence mothers' parenting behaviors. Positive associations between child pro-social behavior and receptive vocabulary, as well as supportive parenting, were observed across early child development. The magnitude of these associations steadily declined over time, highlighting the importance of early synergistic parent-child interactions. Patterns of change in child pro-social behavior skills and supportive parenting remained positive and relatively stable, while observed growth in child receptive vocabulary skills increased in magnitude over time. In summary, by utilizing a large longitudinal sample of at-risk families we have extended prior understanding of transactional patterns in parent-child responsivity and specified how the magnitude and stability of these reciprocal behaviors are dynamically evolving due to child-driven effects across early to middle childhood. Further, we have specified how child pro-social behaviors and receptive vocabulary is concurrently and successively shaped in the context of parent and child responsivity and provided recommendations for early intervention timing and dosage.

DATA AVAILABILITY STATEMENT

Publicly available datasets were analyzed in this study. This data can be found at: Fragile Families and Child Wellbeing Study, <https://opr.princeton.edu/archive/>.

ETHICS STATEMENT

This study was exempt from review by the Texas Tech University Institutional Review Board due to the study utilizing completely

de-identified secondary data. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

JB, SP, MC, and AM designed the study. JB and MC prepared the dataset. SP completed initial analyses and additional analyses. JB developed a first draft of the comprehensive manuscript under AM's guidance and revised manuscript to reflect updated findings. All authors provided feedback and implemented manuscript revisions.

All authors contributed to the article and approved the submitted version.

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