How a Preschool Parent Intervention Produced Later Benefits:

A Longitudinal Mediation Analysis

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Abstract

Preschool parent interventions may produce downstream benefits if initial intervention gains are sustained and improve later socialization experiences. This study explored associations between initial effects of the REDI (Research-based Developmentally Informed) Parent program and later benefits. A randomized trial involving 200 Head Start children (55% European-American, 26% African American, 19% Latino, 56% male, M_{age} = 4.45 years) produced kindergarten gains in parenting and child skills. Four years later, sustained effects were evident in areas of academic performance and social-emotional competence at school and new benefits emerged at home. Initial gains in child academic and social-emotional domains mediated sustained gains within the same domains. In addition, initial gains in parent-child conversations, parent academic expectations, and child social-emotional skills mediated later reductions in parenting stress and child problems at home. Parent-focused preschool interventions may not only promote sustained improvements in child school adjustment but may also foster better family functioning over time.

How a Preschool Parent Intervention Produced Later Benefits: A Longitudinal Mediation Analysis

Children growing up in poverty often start school with less well-developed social-emotional and language skills than their more advantaged peers (Ryan, Fauth, & Brooks-Gunn, 2006). Limited financial and educational resources create multiple hardships for families, often exposing parents and children to high levels of chronic stress, compromising effective parenting, and reducing home learning support (Brooks-Gunn & Markman, 2005). These adversities impede the development of the prefrontal cortex during the early childhood years and diminish child progress in acquiring the language and self-regulatory skills that provide a critical foundation for controlling attention, managing emotions, inhibiting impulses, and approaching problems with flexibility and persistence (Blair & Raver, 2015). The result is a socio-economic gap in key competencies that support school success, evident across the dual domains of language/emergent literacy skills and social-emotional/self-regulatory functioning (Blair & Raver, 2015). This gap does not diminish in later years but predicts to persistent socio-economic disparities in effective social adjustment, learning engagement, and academic performance (Ryan et al., 2006).

Although the context of poverty creates challenges, research suggests that preschool parent interventions can boost children's school readiness and initial school success (Bierman, Welsh, Heinrichs, Nix, & Mathis, 2015; Brotman et al., 2013; Ford, McDougall, & Evans, 2009; Lunkenheimer et al., 2008). Intervening during early childhood may be particularly strategic, as this is a period of malleable neurodevelopment when skill acquisition is heavily influenced by contextual factors, creating the potential for increased parental support to benefit later developmental trajectories (Knudsen, Heckman, Cameron, & Shonkoff, 2006).

Conceptually, preschool parent interventions might have long-lasting benefits for both children and parents. For example, short-term intervention boosts in parenting skills might continue over time and support on-going improvements in child adjustment well after the intervention period (Brotman et al., 2008). Alternatively, or in addition, preschool parent interventions might promote child skills that reduce child risk for later problems and, concomitantly, reduce parent experiences of stress and hassles (Bierman, Welsh, Heinrichs, & Nix, 2018).

Although it is intriguing to speculate about the potential sustained and emerging benefits that might accrue from strategic preschool parent interventions, little empirical data exist on this topic. Rarely have studies of preschool parent interventions included follow-up assessments in the later elementary school years to document sustained effects, and even less often have these studies tested the pathways linking immediate post-intervention effects with sustained or later-emerging benefits to illuminate potential mechanisms of action (Sandler, Schoenfelder, Wolchik, & MacKinnon, 2011).

This study addressed this gap in the literature, using data from the Research-based Developmentally Informed Parent (REDI-P) intervention program. This parent-focused intervention, delivered as children transitioned from Head Start into elementary school, produced post-intervention improvements in three domains at kindergarten: parent support for learning, child social-emotional competence, and child emergent literacy skills (Bierman et al., 2015). Follow-up assessments conducted in third grade showed sustained intervention benefits in areas of academic performance and social-emotional competence. REDI-P also produced later benefits in new areas that were not evident immediately after intervention, promoting reductions in parenting stress and child behavior problems at home (Bierman et al., 2018). The present study

modeled the associations of the immediate post-intervention responses of parents and children with the sustained child skills and newly emerging improvements in parent-child functioning at home, to determine how the short-term benefits produced by the program may have mediated later outcomes.

The REDI Parent Intervention

REDI-P was designed to extend the longitudinal impact of the Head Start REDI classroom program (REDI-C; Bierman et al., 2008) and included intervention components that were aligned with the classroom program. Across REDI-C and REDI-P, intervention activities targeted growth in two core skill domains linked with school success and associated with delays among children growing up in poverty: language/emergent-literacy skills and social-emotional/self-regulation skills. By coordinating evidence-based programming across these core skill domains and across home and school contexts, REDI sought to stimulate synergistic gains that would enhance school readiness and promote sustained benefits for children (Nix, Bierman, Domitrovich, & Gill, 2013).

In the classroom, REDI used the Preschool PATHS (Promoting Alternative Thinking Strategies) Curriculum to support the acquisition of prosocial skills, emotional understanding, and self-regulation of emotion and behavior (Domitrovich, Cortes, & Greenberg, 2007; Riggs, Greenberg, Kusche, & Pentz, 2006). Designed to parallel PATHS and promote social-emotional learning at home, REDI-P included stories, games, and activities that featured the PATHS characters and skills. Parent-child activities included feeling face games to teach emotion knowledge and story-based reviews of the “Turtle Technique” to encourage emotion regulation and impulse control. In the classroom, REDI-C integrated a dialogic reading program with PATHS to promote oral language skills and reinforce social-emotional learning.

Correspondingly, REDI-P showed parents how to use interactive reading strategies at home and coached parents in the use of questions and expansions to support child language development. REDI-P also provided parent-child games to teach letter names and sounds and included guidelines and props to support literacy-infused dramatic play (Bierman et al. 2015). In addition to receiving home learning activities to use with their children, parents were coached by home visitors and shown how to introduce and reinforce skills associated with positive social interaction, emotion regulation, and self-control, along with how to extend and enhance parent-child conversations and discussions.

REDI-P was delivered during 10 home visits scheduled during the spring of the prekindergarten year and 6 supplemental home visits scheduled between August and October of the kindergarten year. The decision to deliver REDI-P before and after children transitioned from Head Start into kindergarten was strategic and based on prior recommendations regarding the value of positive parent engagement at this critical juncture (Rimm-Kaufman & Pianta, 1999). Normatively, parent support for child learning decreases as children move from preschool into kindergarten, as parents engage in fewer learning activities at home (Powell, Son, File, & Froiland, 2012) and have less frequent and less positive interactions with teachers (Rimm-Kaufman & Pianta, 1999). Yet, research suggests that when parents sustain or increase their efforts to support child learning during the transition into elementary school, children benefit in areas of both academic progress and social-emotional adjustment (El Nokali, Bachman, & Votruba-Drzal, 2010; Powell et al., 2012). The REDI-P home visits held at the start of the kindergarten year were designed to reinforce and sustain parent use of the learning support strategies that were a focus of the 10 prekindergarten visits, and also to encourage family routines and parent-school communication to build positive connections between home and

school.

To evaluate program impact, children in Head Start classrooms that were using the REDI classroom program were randomly assigned to receive REDI-P home visiting or to receive limited math-focused games in the mail (the control condition). Hence, the trial compared groups of children who received the combination of REDI-C and REDI-P with groups of children who received REDI-C alone. Post-intervention assessments in kindergarten showed that REDI-P improved parent-child conversations, increased parent interactive reading, and enhanced parent academic expectations (d = .27- .28), as well as increasing child language/emergent literacy and social-emotional/self-regulation skills relative to the control group (d = .25 to .29; Bierman et al., 2015). These effect sizes are within the range of small to medium effects typically reported for parent-focused school readiness interventions (Brotman et al., 2013; Brotman et al., 2016; Manz, Hughes, Barnabas, Bracaliello, & Ginsburg-Block, 2010). At a follow-up assessment conducted when children were in third grade, children who had received REDI-P continued to show enhanced academic performance (d = .28-.29) and social-emotional skills (d = .35). In addition, new benefits were evident in areas of reduced parenting stress (d = .27) and fewer child problems at home (d = .28; see Bierman et al., 2018 for more details.)

Mechanisms of Action in Parent-Focused School Readiness Interventions

REDI-P is one example of a preschool parent intervention for low-income families designed to promote parent support for learning and child school readiness skills (see reviews by Reese, Sparks, & Leyva, 2010; Welsh, Bierman, & Mathis, 2014). These parent interventions have typically been informed by two kinds of logic models – those with a primary emphasis on improving parenting practices to support child behavioral school readiness, and those with a primary emphasis on promoting home learning activities designed to strengthen child language

and academic skills. REDI-P combined these approaches, targeting both improved parenting practices and providing home learning activities to strengthen child skills.

Emphasizing parenting practices. Informed largely by attachment and social learning theories, several preschool parent interventions focus on increasing positive parenting skills, such as improving parent sensitivity and warmth, fostering the use of specific praise and logical consequences, decreasing directiveness and punitive responding, and improving parent-child communication (see Webster-Stratton & Taylor, 2001 for a review). For example, Webster-Stratton, Reid, and Hammond (2001) delivered the Incredible Years Parent Training Program to parents of children attending Head Start, producing improvements in parenting practices and decreases in child conduct problems at school. Supporting the logic model guiding this approach to intervention, short-term studies have demonstrated that improved parenting practices mediate reductions in child conduct problems (Brotman et al., 2009; Gardner, Burton, & Klimes, 2006; Reid, Webster-Stratton, & Baydar, 2004) and in some cases also promote gains in child language and social skills (Landry, Smith, Swank, & Guttentag, 2008; Lunkenheimer et al., 2008). Intervention gains in parenting skills in the short run might also produce sustained and even later-emerging benefits for children in the years following intervention as a function of improved parent-child relationships (Webster-Stratton & Taylor, 2001).

Emphasizing home learning activities that teach academic skills. An alternative approach to preschool intervention is to help parents use specific learning activities and teaching strategies to promote child language and emergent literacy skills (see reviews by Mol, Bus, DeJong, & Smeets, 2008; Reese et al., 2010). The underlying logic model of this approach emphasizes the instructional value of teaching activities, materials, and instructional strategies to enhance child skill acquisition. For example, parents have been taught to use interactive reading

strategies at home, asking questions and prompting their children to describe the pictures and events in the stories. Meta-analyses document the positive effects of interactive parent-child reading programs on the development of child language skills (Mol et al., 2008; Reese et al., 2010). Prior studies have also validated the positive impact of parent-child play with activities that involve letter identification and letter-sound skill practice, producing benefits in language and literacy skills (see review by Evans & Shaw, 2008) and, in some cases, additional benefits in social-emotional skills (Ford et al., 2009).

These programs focus on parent use of specific learning materials and strategies as the key factors promoting child skill acquisition (Reese et al., 2010). Studies of short-term changes during intervention document significant associations of parent use of the home learning activities and/or teaching strategies with gains in child emergent literacy skills (Jordan, Snow, & Porche, 2000; Justice & Ezell, 2000). Conceptually, longer-term or later-emerging benefits from these teaching interventions might occur if the targeted child skills place children on a trajectory of greater school success, thereby reducing learning or adjustment problems in later years.

The dual-focus approach of REDI-P. The REDI-P intervention included a dual focus, as it taught parents specific interactive reading strategies and provided scripted home learning activities, and it also included general parent coaching designed to increase positive behavioral support and enhance parent-child communication. Initial analyses suggested that the frequency with which parents used the home learning materials and parents' general understanding of (and openness to) the REDI parenting strategies during intervention were both significant predictors of post-intervention gains in child literacy skills and social-emotional competence at home, controlling for baseline levels (Nix, Bierman, Motamedi, Heinrichs, & Gill, 2018). In addition, increases in broader indices of parent efficacy (reflected in parent academic expectations)

emerged as a key mediator of post-intervention gains in child emergent literacy skills and adaptive learning behaviors (Loughlin-Presnal & Bierman, 2017).

Exploring Mechanisms Underlying Longer-Term Parent Program Effects

Whereas several studies have explored the mechanisms of action accounting for initial preschool parent intervention effects, few have undertaken longer-term follow-up studies designed to understand the mechanisms accounting for potential downstream effects in the years following the intervention. Conceptually, longer-term benefits might emerge because of sustained gains in parenting skills (Brotman et al., 2008; Strayhorn & Weidman, 1991; Webster-Stratton & Taylor, 2001), improved parental self-efficacy (Sandler et al., 2011), or sustained gains in child skills, which may all improve the socialization opportunities (or reduce the socialization risks) experienced by children over time and thereby produce sustained or emerging benefits (Sandler et al., 2011). In this study, we anticipated that the set of parenting practices and child skills that were significantly affected by intervention in the short run (e.g., at the post-intervention assessments in kindergarten) were potential mediators of the longer term sustained or emerging intervention effects observed at the end of third grade.

The Present Study

This study was designed to illuminate the pathways accounting for reductions in child problems and parenting stress that emerged in the third-grade follow-up assessments of REDI-P, four years after the preschool intervention. To do so, structural equation models tested the degree to which the initial post-intervention effects on parents and children mediated these later-emerging improvements in parent-child functioning. Potential mediators included three domains in which the intervention produced significant post-intervention benefits, including: 1) parent support for learning (parent-child conversations, reading quality, and parent academic

expectations), 2) child social-emotional skills (social competence, adaptive learning behaviors), and 3) child emergent literacy skills (letter identification, letter-sound recognition, letter-word knowledge). It was hypothesized that initial effects within the child skill domains of literacy skills/academic performance and social-emotional competence would mediate later sustained effects in the same domains. For the emerging third grade effects, it was hypothesized that initial intervention effects on both parent and child skills would contribute significantly, jointly mediating the emerging longer-term improvements evident in parent-child functioning.

Method

Participants

Participants included 200 parents and prekindergarten children attending Head Start (55% European American, 26% African American, 19% Latino; 56% male), with a mean age of 4.45 years old (*SD* = .29) at the time of pre-intervention assessment in the fall of prekindergarten. Over two successive years, families were recruited from 24 Head Start centers in three counties by sending letters home with the children describing the study; 52% indicated interest in the study. The final sample (n = 95 for REDI-P intervention group and n = 105 for the comparison group) included families with a median annual family income of $18,000, with 54% unemployed. Most participating parents had completed high school (66%), although some had not completed high school (17%), some had attained a 2-year degree or technical certificate (21%), and several had a college degree (4%). Slightly over one-third of the parents (36%) were single; others were married (36%) or living with a committed partner (25%). Children were randomized at the level of the individual (within classroom) after stratifying on county and cohort. Intervention and comparison groups were equivalent on the demographic variables of

child gender, child race/ethnicity, maternal education, single-parent status, and maternal employment.

After leaving Head Start, children were widely dispersed, transitioning into 149 kindergarten classrooms in 74 schools. They were followed through third grade. The attrition rate was about 4% per year, due primarily to family moves; by the 3rd grade, data were available for 80% of the sample. Comparison of the retained and lost samples demonstrated that attrition was not significantly related to any baseline child or family characteristics or any of the variables studied here (all $p > .05$; see Table A in the on-line supplementary materials for baseline comparisons of attritted and retained participants). All participants were included in the analyses; missing data were accounted for using full information likelihood methods (FIML).

Intervention

REDI-P included 10 home visits during the spring of the child's Head Start prekindergarten year and six "booster" sessions after the child transitioned into kindergarten. Home visitors used a well-specified manualized curriculum to provide parents with home learning activities and coach them in parenting strategies designed to boost child language/emergent literacy and social-emotional skills. Parents were shown how to use dialogic reading strategies and they were provided with modeling stories that featured characters from the classroom PATHS curriculum designed to teach social-emotional skills. Parents also received monthly activity boxes containing play materials designed to support parent-child dramatic play, letter identification, and print concept practice. For example, materials for "playing restaurant" at home included an alphabet soup letter identification game, menu sight words, and opportunities to practice writing when taking restaurant orders. Ready-to-use materials had low literacy demands and included embedded guidelines and illustrations. Embedded questions in the

stories and games encouraged parent-child conversations and helped parents reinforce target social-emotional skills. During home visits, discussions, role-plays, and videotape reviews were used to coach parents in positive parenting strategies, including the use of compliments and specific praise, emotion coaching, and supporting self-control with the use of the "Turtle Technique" (a self-calming ritual) and collaborative problem-solving. In addition, the intervention stressed the importance of parent-child communication and provided guidance in the use of questions and expansions to foster child language skills. The kindergarten sessions followed the same structure as the prekindergarten sessions, with an ongoing emphasis on parent-child communication and problem-solving, and an additional focus on establishing family routines to support healthy sleep and school attendance.

The six home visitors were recruited from the communities where Head Start centers were located. All had undergraduate degrees in early education or human services and experience working with parents of young children. They received five days of in-person training and had weekly supervision. In addition, the supervisor made a bi-monthly visit to each site, attending 20% of the home visits to provide individual feedback and guidance to each home visitor, and to assure standard intervention implementation across the various home visitors. Sixteen percent of the intervention families reported that Spanish was spoken in the home; all of these families reported that English was spoken as well. These families were provided with a Spanish-speaking home visitor and were offered intervention materials in Spanish, but all opted for English materials to use with their children.

On average, parents completed 12 of the 16 planned sessions (M = 12.00, SD = 5.48, range = 0 – 16). Most of the parents (80%) received most of the preschool visits (at least 8 out of 10); a smaller majority (65%) received most of the kindergarten visits (at least 5 out of 6). On a

scale that required home visitors to rate parents on the amount and quality of use of the materials, the mean (averaged across sessions) was 2.27 out of a possible 3 (*SD* = 0.54, range = 0.74 – 3). Analyses reported here are "intent to treat" and include all families randomized to intervention or control conditions.

Procedures

Assessments used in this study were collected at three time points: 1) pre-intervention (fall of the prekindergarten year in Head Start), 2) post-intervention (spring of the kindergarten year), and 3) follow-up (spring of the third-grade year). At each time point, trained research assistants visited homes to interview parents and collect parent-rated measures, and they visited schools to explain rating forms to teachers and conduct child assessments during individual pull-out sessions. Research assistants and teachers in Head Start, kindergarten, and third-grade were naïve concerning the intervention or comparison group status of children and families. Parents and teachers were compensated financially for the assessments.

Measures

Kindergarten outcomes. In this study, outcomes that reflected the immediate impact of the intervention assessed in kindergarten were tested as mediators of the longer-term impact of the intervention on outcomes that emerged in third grade, with pre-intervention measures serving as control covariates.

Parent support for learning. Parents reported on the quality of their reading interactions with their child, using an abbreviated version of the verbal participation subscale of the *Reading Belief Inventory* (DeBaryshe & Binder, 1994). Five items described the use of interactive reading strategies (e.g., I ask my child a lot of questions when we read; When we read, we talk about the pictures as much as we read the story), each rated with a 4-point scale (*strongly disagree* to

strongly agree, α = .78). Parent responses were averaged across items. Parents also reported on the quality of their conversations with their young children using 4 questions developed for this study (e.g., How many times in a typical week do you and your child have a conversation that lasts 10 minutes or more? How often does your child volunteer to tell you about something that happened when you were not with him or her?) each rated on a 6-point scale (*almost always* to *almost never*). Item responses were averaged (sample α = 0.56), with higher scores reflecting longer conversations characterized by more child disclosure. Based upon prior research (Yamamoto & Holloway, 2010), parent academic expectations were assessed with two questions: "Knowing your child as you do, how far do you think she or he will go in school?" and "Knowing your child as you do, what is the average grade you expect him/her to receive in school?" Each item was rated on a 7-point rating scale, with higher values indicating more positive academic expectations (1 = 0 – 8th grade/lower than Cs; 7 = more than four years of college/receive As). Ratings on these two questions were significantly correlated, (r = .58) and were averaged to represent parent academic expectations.

Social-emotional competence. Three teacher-rated measures assessed social-emotional competence in kindergarten. Teachers rated children on the *Social Competence Scale* (Conduct Problems Prevention Research Group [CPPRG], 1995) which included 13 items describing prosocial behavior (e.g., sharing, helping) and emotion regulation (e.g., ability to calm down when upset); α = .93. Ratings were made on a 6-point Likert scale (1 = *never* to 6 = *almost always*), and item scores were averaged. Teachers also rated children's adaptive learning behaviors with 5 items from the *School Readiness Questionnaire* (e.g., can work independently, has the self-control to do well in school; Bierman et al., 2008), each rated on a 6-point Likert scale (1 = *strongly disagree* to 6 = *strongly agree*), and 5 items from the *Learning Behaviors*

Scale (e.g., responds in a manner that shows attention, accepts new tasks without resistance; McDermott, Green, Francis, & Stott, 1999), each rated on a 3-point Likert scale (1 = *does not apply* to 3 = *most often applies*); subscales were standardized and averaged to reflect adaptive learning behaviors (α = .91).

***Emergent literacy skills*.** Direct assessments of child literacy skills were collected at the end of kindergarten. These included the Letter-Word Identification scale of the *Woodcock-Johnson Tests of Achievement III – Revised,* which assessed letter knowledge and sight word recognition (Woodcock, McGrew, & Mather, 2001); the Letter Naming Fluency subscale of the *Dynamic Indicators of Basic Early Literacy Skills*, which tallied the number of letters correctly identified in one minute (Good, Gruba, & Kaminski, 2001), and Letter Sound Fluency, which tallied the number of letter sounds correctly produced in one minute. Raw scores on these three literacy skill assessments were used in analyses.

Third grade outcomes. Direct assessments, teacher ratings, and parent ratings were collected at the third-grade follow-up assessments to assess academic performance, social-emotional competence, parent stress, and child problems at home.

Academic performance. In third grade, children were administered the sight words subtest of the *Test of Word Reading Efficiency* (Torgesen, Wagner, & Rashotte, 1999) which measured sight word fluency (total items read correctly in 45 seconds; test-retest reliability reported by the developers of .85 - .90). In addition, third grade teachers completed the *Academic Competence Evaluation Scales* (DiPerna & Elliott, 1999) which assessed academic achievement in reading and language arts (11 items on 5-point scale; α = .97), math (8 items; α = .98), critical thinking (9 items; α = .97), and academic motivation (11 items; α = .97). Scores on these subscales were standardized and averaged.

Social-emotional competence. Teachers rated children on the *Social Competence Scale* (CPPRG, 1995), described above, assessing prosocial skills and emotion regulation skills (α = .94). To reflect adaptive learning behaviors, teachers also completed the 8-item Inattentive-Impulsive subscale of the *ADHD Rating Scale* (DuPaul, 1991), rating attention problems (e.g., easily distracted, trouble following directions) on a 4-point scale (1 = not at all to 4 = very much; α = .93 – .96). In addition, adaptive learning behaviors at third grade were assessed using examiners ratings on a short version of the *Adapted Leiter-R Assessor Report* (Smith-Donald, Raver, Hayes, & Richardson, 2007) which assessed learning behaviors observed during the assessment, including attention, impulse control, and mastery motivation (13 items on 4-point scale; α = .89).

Parenting stress. Parents rated their parenting stress and daily hassles on a short version of the *Childrearing Stress* subscale of the *Parenting Stress Index*, comprised of the 9 highest-loading items on that subscale (Abidin, 1995; Haskett, Ahern, Ward, & Allaire, 2006; 9 items each rated on 6-point scale; α = .82). Parents also completed the *Parenting Daily Hassles* scale (Crnic & Greenberg, 1990; 12 items each rated on 4-point scale; α = .76). Scores on these two measures were correlated (*r* = .44) and they were averaged for analyses.

Child problems at home. Parents rated child problems at home on the *Strengths and Difficulties Questionnaire* (Goodman, 1997), with total problems reflecting emotional symptoms, peer problems, conduct problems and hyperactivity (20 items each rated on 3-point scale; α = .84). A summed score was used in analyses.

Baseline covariates. Models included demographics (family income, single-parent household, financial stressors, maternal depression, child sex and age), design parameters (cohort, county site), and pre-intervention measures of study outcomes as control variables. In

addition, to fully control for the impact of the child's initial cognitive ability on school readiness and subsequent adjustment, pre-intervention measures of cognitive ability were also included as covariates in all analyses. These measures were Block Design from the *Wechsler Preschool and Primary Scale of Intelligence - III* (Wechsler, 2002) and vocabulary (EOWPVT, Brownell, 2000), as well as measures of child executive functioning (Backward Word Span, Peg Tapping, Dimensional Change Card Sort, Walk-a-Line Slowly) and the *Adapted Leiter-R Assessor Report* (Smith-Donald, Raver, Hayes, & Richardson, 2007).

Data Analysis Plan

Data analyses proceeded in three steps. First, preliminary analyses examined simple correlations among measures. Second, measurement models were tested to evaluate the three latent constructs representing potential mediators: parent support for learning (represented by parent-child conversations, reading quality, and parent academic expectations), child social-emotional skills (represented by social competence and adaptive learning behaviors), and child emergent literacy skills (represented by letter-naming, letter-sound, and letter-word scores). Finally, multilevel path analyses using structural equation models (SEM; Mplus version 7; Muthén & Muthén, 2012) were computed to evaluate hypothesized mediation of sustained third grade outcomes (child academic performance, social-emotional competence) and emerging third grade outcomes (parenting stress, child problems at home). These models controlled for the set of level 1 family and child covariates listed above and nested children within the level 2 variables of county (three counties) and cohort (two cohorts). Missing data were accounted for using full information likelihood (FIML).

Separate models were run for each third-grade outcome. In each case, an initial baseline model estimated the direct effect of the intervention on the third-grade outcome, and then the

mediators were added. For each model, we report Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), and Standardized Root Mean Square Residual (SRMR), interpreting an adequate fit with RMSEA $\leq$ .08, CFI $\geq$ .92, and SRMR $\leq$ .08.

Results

Preliminary Analyses

Descriptive statistics and correlations between the study variables at kindergarten and third grade are presented in Table 1. In kindergarten, parent-child conversations and parent academic expectations (but not parent-reported reading quality) were concurrently correlated with measures of emergent literacy skills and social-emotional competence. In addition, measures of kindergarten emergent literacy and social-emotional skills were significantly correlated with each other (r = 0.20 to r = 0.42). Within-domain correlations were significant across time (kindergarten to third grade) for literacy skills/academic performance (r = 0.48 to r = 0.66) and for social competence/learning behaviors (r = 0.27 to r = 0.45). Finally, kindergarten parent-child conversations and academic expectations were predictive of reduced parenting stress and child problems in third grade, as well as enhanced learning behaviors and academic performance.

Prior to computing the SEMs, a measurement model was estimated to assess relations among the observed measures and latent constructs. Fit indices for the measurement model suggested that the hypothesized relations among observed measures and latent constructs represented a marginally adequate fit to the data, RMSEA = .11, CFI = .90, SRMR = .06. Associations between observed measures and the latent construct of parent support for learning fell below .50. Due to the lack of coherence in the measures of parent support for learning, the model was re-evaluated using manifest variables (rather than a latent construct) to

represent the parenting variables. This revised measurement model showed improved fit indices, RMSEA = .09, CFI = .92, SRMR = .06.

Hypothesis Testing

Academic performance. First, we examined intervention processes associated with sustained intervention effects in the domain of academic performance in third grade. As expected, a main effect for intervention emerged in this multilevel path model, with intervention improving academic performance in third grade, $\beta = 0.23$, $p = .001$. Then, the mediators were included and the expanded model showed an adequate fit to the data, RMSEA = .07; CFI = .90; SRMR = .04. As shown in Figure 1, the REDI-P intervention had a significant effect promoting each of the potential mediators, and in turn, child emergent literacy skills and parent academic expectations in kindergarten each uniquely predicted improvements in academic performance in third grade. Follow-up analyses using a test of the asymmetric confidence intervals demonstrated that intervention-related gains in both emergent literacy skills and parent academic expectations significantly mediated the effect of the intervention on improved academic performance, $\mu = 0.10$, $p < .05$, CI [0.03, 0.19] and $\mu = 0.01$, $p < .05$, CI [0.002, 0.03], respectively. The total indirect effect of REDI-P on improved academic performance was statistically significant as determined using boot-strapped errors, $\beta = 0.12$, CI [0.06, 0.18]. Altogether, the mediators accounted for 34% of the total effect of REDI-P on improved academic performance.

Child social-emotional competence. Next, we examined intervention processes associated with sustained effects on social-emotional competence in third grade. A marginally significant main effect for intervention emerged, with intervention improving social-emotional competence, $\beta = 0.17$, $p = 0.09$. Next the mediators were added, and the expanded model fit the data adequately, RMSEA = .08; CFI = .81; SRMR = .07. As shown in Figure 2, the REDI-P

intervention had a significant effect promoting each of the potential mediators, and in turn, child social-emotional competence in kindergarten uniquely predicted social-emotional competence in third grade. Follow-up analyses using a test of the asymmetric confidence intervals demonstrated that intervention-related gains in social-emotional competence at post-intervention significantly mediated the effect of the REDI-P intervention on improved social competence in third grade, $\mu = 0.06$, $p < .05$, CI [0.03, 0.10]. The total indirect effect of REDI-P on third grade social-emotional competence was marginally significant as determined using boot-strapped errors, $\beta = 0.09$, CI [-0.03, 0.21]. Altogether, the mediator accounted for 50% of the total effect of REDI-P on third grade social-emotional competence.

Parenting stress. Next, we examined the intervention outcomes that emerged at the third-grade follow-up assessments, starting with reductions in parenting stress. As expected, a main effect for intervention emerged in the multilevel path model, with intervention reducing parenting stress in third grade ($\beta = -0.15$, $p = .006$). Then, the mediators were included, and the expanded model showed an adequate fit to the data, RMSEA=.06; CFI=.92; SRMR=.04. As shown in Figure 3, the REDI-P intervention had a significant effect promoting each of the potential mediators, and in turn, child social-emotional skills and parent-child conversations each uniquely predicted reductions in parenting stress. Follow-up analyses using a test of the asymmetric confidence intervals demonstrated that intervention-related gains in both social-emotional skills and parent-child conversations significantly mediated the effect of the intervention on reduced parenting stress, $\mu = 0.02$, $p < .05$, CI [0.01, 0.05] and $\mu = 0.05$, $p < .05$, CI [0.01, 0.09], respectively. The total indirect effect of REDI-P on reduced parenting stress was statistically significant based on boot-strapped errors, $\beta = -0.06$, CI [-0.11, -0.01]. Altogether, the mediators accounted for 37% of the total effect of REDI-P on reduced parenting stress.

Child problems at home. Finally, we examined intervention processes associated with reduced child problems at home in third grade. A significant main effect for intervention emerged, with intervention reducing child problems at home, $\beta = -0.15$, $p < .001$. Next the mediators were added, and the expanded model fit the data adequately, RMSEA=.06; CFI=.92; SRMR=.04. As shown in Figure 4, the REDI-P intervention had a significant effect promoting each of the potential mediators, and in turn, child social-emotional skills, parent-child conversations, and parent academic expectations each uniquely predicted reductions in child problems at home. Follow-up analyses using a test of the asymmetric confidence intervals demonstrated that intervention-related gains in each of these three areas significantly mediated the effect of the REDI-P intervention on reduced child problems, $\mu = 0.04$, $p < .05$, CI [0.01, 0.08]; $\mu = 0.05$, $p < .05$, CI [0.03, 0.09]; and $\mu = 0.02$, $p < .05$, CI [0.01, 0.04], respectively. The total indirect effect of REDI-P on reduced problems at home was statistically significant as determined using boot-strapped errors, $\beta = -0.11$, CI [-0.21, -0.01]. Altogether, the mediators accounted for 60% of the total effect of REDI-P on reduced problems at home.

Discussion

Preschool interventions targeting the school readiness of children from low-income families hope to positively influence their developmental trajectories, thereby promoting future school adjustment and attainment and reducing educational disparities. Conceptually, parents play a critical role in providing ongoing support for children's well-being and education, and preschool parent interventions may be strategically effective because of the potential for downstream benefits associated with altering children's developmental experiences in positive ways (Sandler et al., 2011). At the same time, relatively little research has examined developmental processes that may account for the sustained or later-emerging benefits of

preschool parent interventions. This study addressed this gap in the literature by modeling the mediators of the sustained effects of the REDI-P intervention program on social-emotional competencies and academic performance, along with the later-emerging intervention effects on two key indices of parent-child functioning – parenting stress and child problems at home.

Using structural equation modeling (SEM) with controls for baseline values and family demographics, multilevel path analyses revealed that initial intervention effects within the child skill domains of literacy skills/academic performance and social-emotional competence were stable, with early intervention effects mediating sustained within-domain effects in third grade. In addition, initial intervention effects on parent-child conversations and child social-emotional skills mediated later cross-domain reductions in parenting stress, whereas intervention effects on parent-child conversations, child social-emotional skills, and parent academic expectations all mediated later reductions in child problems. By clarifying pathways of developmental influence, these findings have important implications for the design of preschool parent interventions.

Implications for the Design of Preschool Parent Interventions

Accumulating research highlights the critical value of early intervention for children growing up in poverty because of the negative impact of poverty-related stress on early development and school readiness (Blair & Raver, 2015). School readiness has emerged as an important intervention target, given longitudinal research linking kindergarten levels of social competence, self-regulation, and emergent academic skills with long-term well-being, including academic attainment, mental and physical health, and future employment (Duncan et al., 2007; Jones, Greenberg, & Crowley, 2015).

Work with parents is viewed as central to early intervention efforts designed to reduce socio-economic gaps in school readiness, both because effective parenting is often jeopardized

by factors associated with poverty (e.g., low levels of formal education, elevated stress exposure, financial insecurity, social isolation), and because of the potential role parents can play in fostering child school readiness and supporting subsequent education and adjustment (Ryan et al., 2006). The ultimate goal of this early intervention is to shift children's developmental trajectories in sustained ways, producing long-term benefits.

At the same time, the logic models of preschool parent intervention are rarely tested with longitudinal data that might illuminate the ways that they influence developmental experiences over time. This is a particularly important question to address for preschool parent interventions because existing evidence-based programs take quite different approaches. That is, two kinds of intervention approaches have proven effective in producing short-term benefits. One approach focuses primarily on improving parenting practices in order to decrease child behavior problems and improve social adjustment at school (Webster-Stratton & Taylor, 2001). The other approach focuses more on parents as tutors, emphasizing parent use of home learning activities and teaching strategies to build specific academic skills (Mol et al., 2008; Reese, Sparks, & Leyva, 2010). Each of these approaches might expect longer-term benefits – the former primarily as a function of improved parenting, and the latter approach primarily as a function of child skill acquisition.

REDI-P offered a unique opportunity to examine developmental processes that linked the short-term benefits of a preschool parent intervention with longer-term, later-emerging benefits. This was possible, in part, because REDI-P was multi-component, providing a home learning program that focused on the parent as a teacher of child skills as well as more general coaching for parents in positive parenting practices. REDI-P also targeted gains in both child social-emotional/self-regulation competencies and language/emergent literacy skills as primary

intervention outcomes. Additionally, REDI-P was unique in terms of timing, as it included home visit sessions that straddled the child's transition from Head Start into kindergarten. This is a time period when parent support for child learning typically decreases (Powell et al., 2012; Rimm-Kaufman & Pianta, 1999), despite evidence that sustained or increased parent support for learning at this transition may have long-term benefits for children (El Nokali, Bachman, & Votruba-Drzal, 2010; Powell et al., 2012). The results of this study suggest that this multi-component, dual-target approach, timed across the transition from preschool to kindergarten, contributed to the later-emerging, downstream intervention benefits. Children showed short-term (kindergarten) gains in both of the targeted skill domains, and these short-term gains mediated sustained gains within the same domains of literacy skills/academic performance and social-emotional/self-regulation skills. In addition, immediate intervention effects in areas of both general parenting (reflected in parent-child conversations and parent academic expectations) and child skills (reflected in child social competence and adaptive learning behaviors) contributed to improvements in parent-child functioning at home four years after the preschool intervention.

This study did not include direct comparisons with parent interventions that took a single domain approach (e.g., focusing either on parenting skills or home learning instruction), so it is unclear whether similar effects would emerge in an intervention that focused more specifically on only one domain. However, it is notable that the downstream benefits were due not only to improved parenting, but also depended upon earlier intervention effects on improved child social-emotional skills and learning behaviors. In this study, child social-emotional skills and learning behaviors were assessed by teacher-ratings in the school setting. This is notable, because it shows that the parent-delivered intervention promoted skills that the child was able to generalize to the school context. It also shows that the association between gains in child social-

emotional skills and later parent-child functioning was not inflated by same-rater biases. Overall, these findings suggest that more longer-term benefits may accrue when preschool parent programs focus both on improving parent-child relationships and on helping parents teach children specific skills, particularly social-emotional skills.

Study Strengths and Limitations

This study had several strengths. By recruiting from Head Start classrooms across three counties, the sample included diverse, low-income families that resided in both rural and small urban communities. In addition to sustained benefits evident in targeted areas of child functioning (e.g., social-emotional competence and academic skills), the follow-up assessments in third grade revealed newly emerging benefits in parent-child functioning that made possible this study's exploration of the pathways associated with those later-emerging effects. The study design also included randomization to intervention and control conditions and a five-year span of measurement, enabling multilevel path analyses that retained the experimental comparison, statistically controlled for multiple pre-intervention confounders, and provided an assessment of child functioning from preschool into middle childhood. The multiple covariates in the statistical models reduced plausible alternative explanations and provided a more precise estimate of mediated intervention effects.

At the same time, several study limitations warrant discussion. Due to unique features associated with the REDI-P intervention, the extent to which these findings may generalize to other parenting interventions is unclear. For example, in this study, all children in both the intervention and control groups received the enriched REDI classroom program in Head Start. Although the effects of the classroom program were thereby controlled in the evaluation of REDI-P, it is not possible to know whether intervention effects would be the same if REDI-P

were delivered as a stand-alone parent intervention rather than an extension of the classroom program. It is also worth noting that this intervention included booster sessions during the fall of the kindergarten year; the effects may have been different if all sessions had been held during the prekindergarten year.

In addition, even with the randomized-controlled design, the models tested here represent possible mechanisms of action but cannot confirm casual links. The measures used to index initial intervention gains for parents and children were limited in scope and method and might well be proxies for unobserved factors that were not directly measured in this study. Unobserved factors such as parent motivation or mental health might account for both initial and later-emerging intervention effects and the potential impact of such unmeasured variables cannot be discounted. This study did not include factors related to the broader school context or school experiences that children had between kindergarten entry and third grade, nor did it attend to factors associated with the broader social ecology in which families lived. For these reasons, the models included here are illustrative of possible mechanisms of action associated with the intervention but fall short of providing a complete or causal explanation of later-emerging intervention effects. The indirect effects observed in this study were small in magnitude, suggesting imprecision of measurement and/or other factors that influenced the third-grade outcomes that were not assessed here. Finally, the sample was relatively small which may have limited statistical power to identify other mediation pathways.

Future Directions

Future studies should consider exploring other potential mediators of longer-term effects and include a consideration of factors at the child level as well as at the parent level. These kinds of mediation studies can contribute to a better understanding of the pathways by which preschool

parent interventions produce downstream benefits and thereby improve the design and effectiveness of early interventions.

In addition, understanding more about possible moderated intervention effects is important. It is possible that school-level and community-level factors may influence the effectiveness and change processes in this kind of parent intervention. These warrant future study. It is also possible that different families navigate interventions like REDI-P in different ways (Mathis & Bierman, 2015) and understanding variations in parent and child response might help tailor interventions to more effectively meet the needs of low-income families. For example, in their work with parents of children attending Head Start, Sheridan, Knoche, Kupzyk, Edwards, and Marvin (2011) found that parent education and health both affected intervention response; intervention was less effective for parents who had less than a high school education or significant health problems. Similarly, lower levels of parent education and income attenuated the effects of parent-focused interactive reading programs in a meta-analysis (Mol et al., 2008). Additional research might reveal whether the processes underlying the effects of these interventions vary for families based on their educational level or income, suggesting a different approach is needed, or whether the approach works in similar ways, but aspects of the delivery (e.g, materials, pacing, coaching strategies) need to be adjusted. In addition, it is important for future research to explore whether the culture, race, or ethnic backgrounds of families alter the mechanisms of action underlying parenting interventions in ways that have implications for intervention design (Manz et al., 2010). The present study included a diverse sample but was not large enough to support the exploration of possible moderation by parent education, income, or background.

Conclusions

Effectively involving parents in preschool interventions may be a key to reducing the fade-out of benefits associated with center-based preschool interventions. That is, whereas children leave their preschool classrooms to enter a new elementary school context, they remain with their parents, giving parents the potential opportunity to support child development and school adjustment across the preschool-to-school transition and over a longer time span. This study illuminated the developmental pathways linking initial intervention responses with later-emerging intervention benefits. The findings demonstrate that parent-focused preschool interventions may not only promote sustained benefits for child school adjustment but may also foster better family functioning over time when they target parent-child communication, parent expectations, and social-emotional learning.

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Table 1

Means, Standard Deviations, and Correlations Among Study Variables.

Variables	Mean	(SD)	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Kindergarten Mediators																
1. Conversation	4.46	(0.93)	--													
2. Reading Quality	3.28	(0.40)	.30**	--												
3. Academic Expects	4.89	(1.00)	.32**	.15*	--											
4. Letter-Word ID	19.42	(5.45)	.18*	.03	.30**	--										
5. Letter-Naming	40.06	(16.10)	.11	.07	.31**	.56**	--									
6. Letter-Sounds	29.59	(15.99)	.10	.10	.27**	.56**	.75**	--								
7. Social Competence	4.31	(0.90)	.11	-.05	.20*	.10	.20**	.27**	--							
8. Learning Behaviors	3.13	(0.71)	.20**	.08	.31**	.30**	.38**	.42**	.70**	--						
Third Grade Outcomes																
9. Parenting Stress	2.31	(0.53)	-.37**	-.13	-.20*	-.05	-.06	-.07	-.21**	-.21**	--					
10. Child Problems	10.37	(6.29)	-.35**	-.05	-.43**	-.11	-.24**	-.17*	-.41**	-.43**	.62**	--				
11. Learning Behaviors	3.64	(0.41)	.14	-.13	.20*	.27**	.25**	.18*	.27**	.32**	-.16	-.23**	--			
12. Inattention	0.92	(0.80)	-.26**	-.19*	-.19*	-.31**	-.39**	-.36**	-.27**	-.45**	.24**	.37**	-.24**	--		
13. Social Competence	4.28	(1.04)	.02	.01	.15	.13	.27**	.28**	.45**	.43**	-.12	-.32**	.37**	-.52**	--	
14. Sight Words	56.02	(14.31)	.16	-.01	.40**	.55**	.66**	.52**	.14	.34**	-.03	-.23**	.37**	-.29**	.27**	--
15. Academic Ratings	0.00	(1.88)	.24**	-.05	.32**	.55**	.54**	.48**	.26**	.45**	-.09	-.27**	.35**	-.53**	.40**	.65**

Notes: SD = standard deviation, expects = expectations, ID = identification. * $p < .05$. ** $p < .01$.

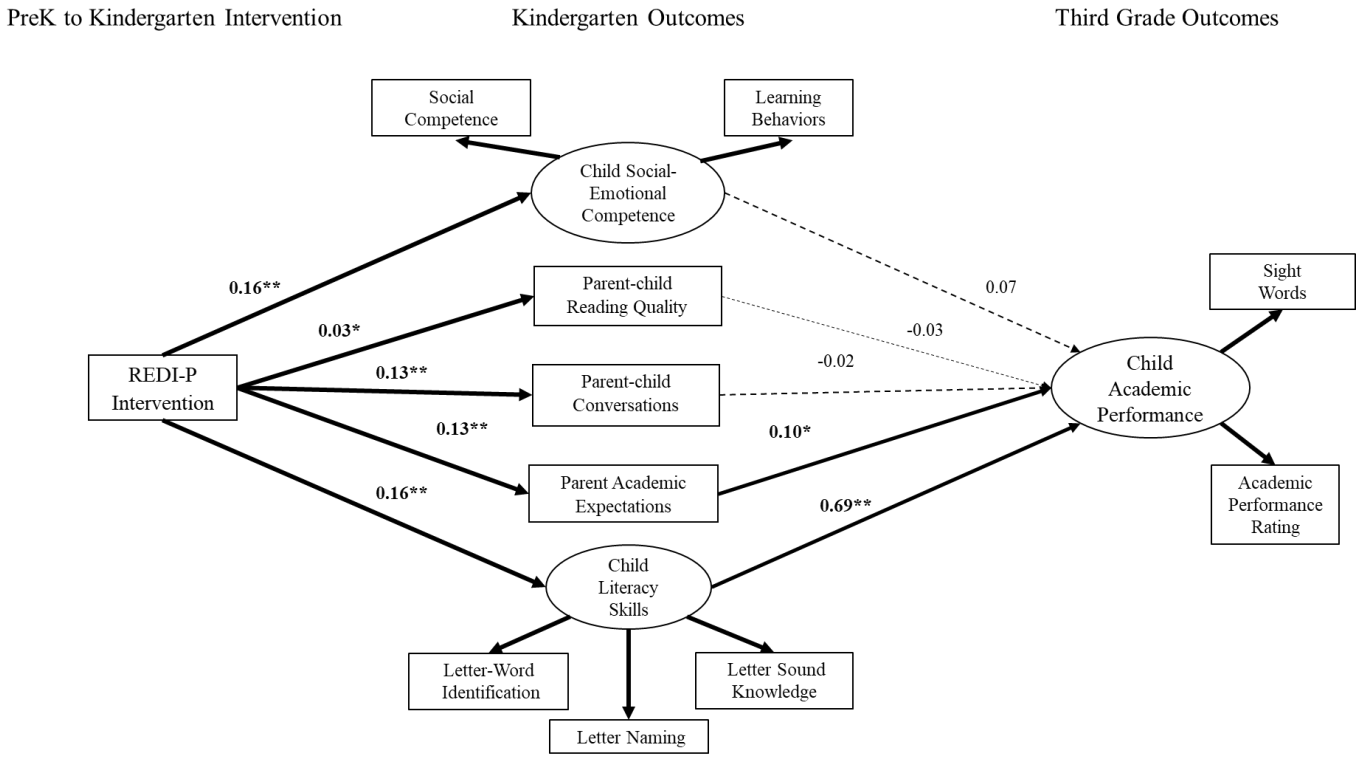

Figure 1. Model of mediated intervention effects on child academic performance in third grade using the standardized coefficients.
* $p < .05$. ** $p < .01$

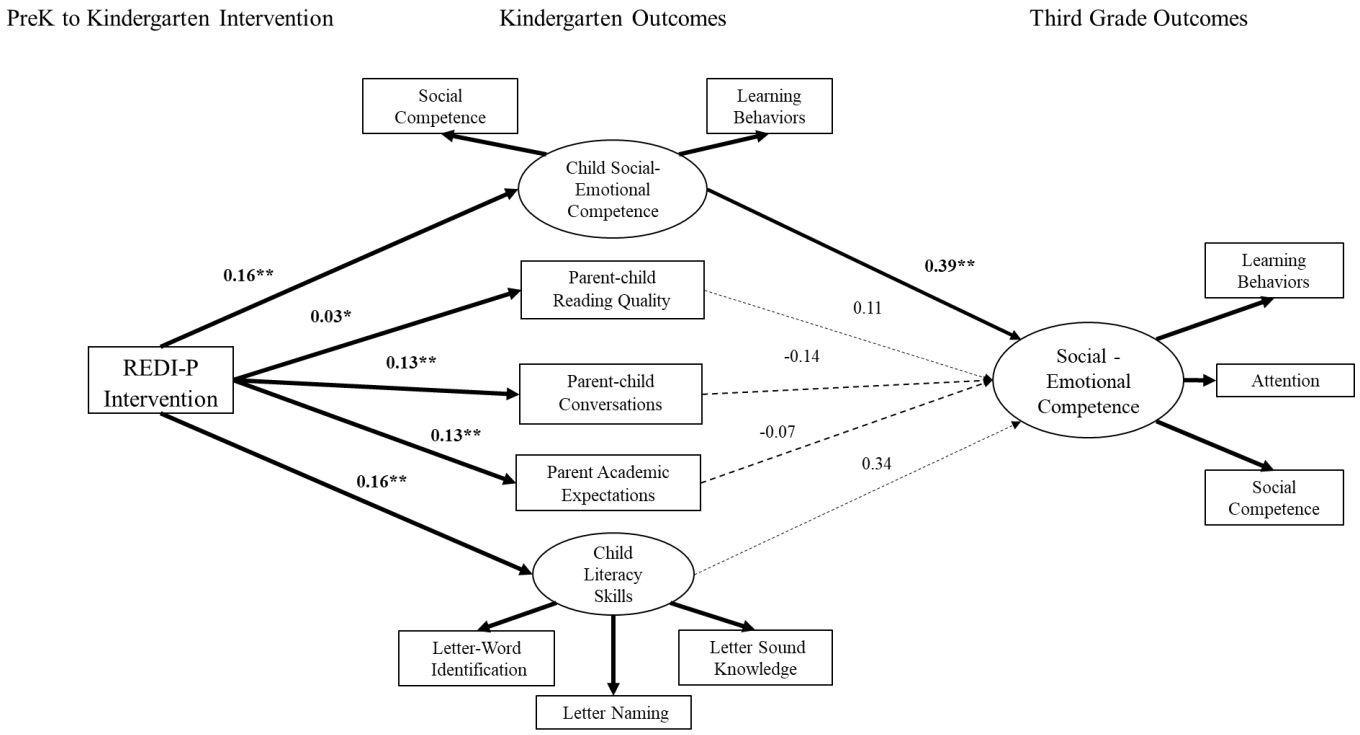

Figure 2. Model of mediated intervention effects on child social-emotional competence in third grade using the standardized coefficients.
* $p < .05$. ** $p < .01$

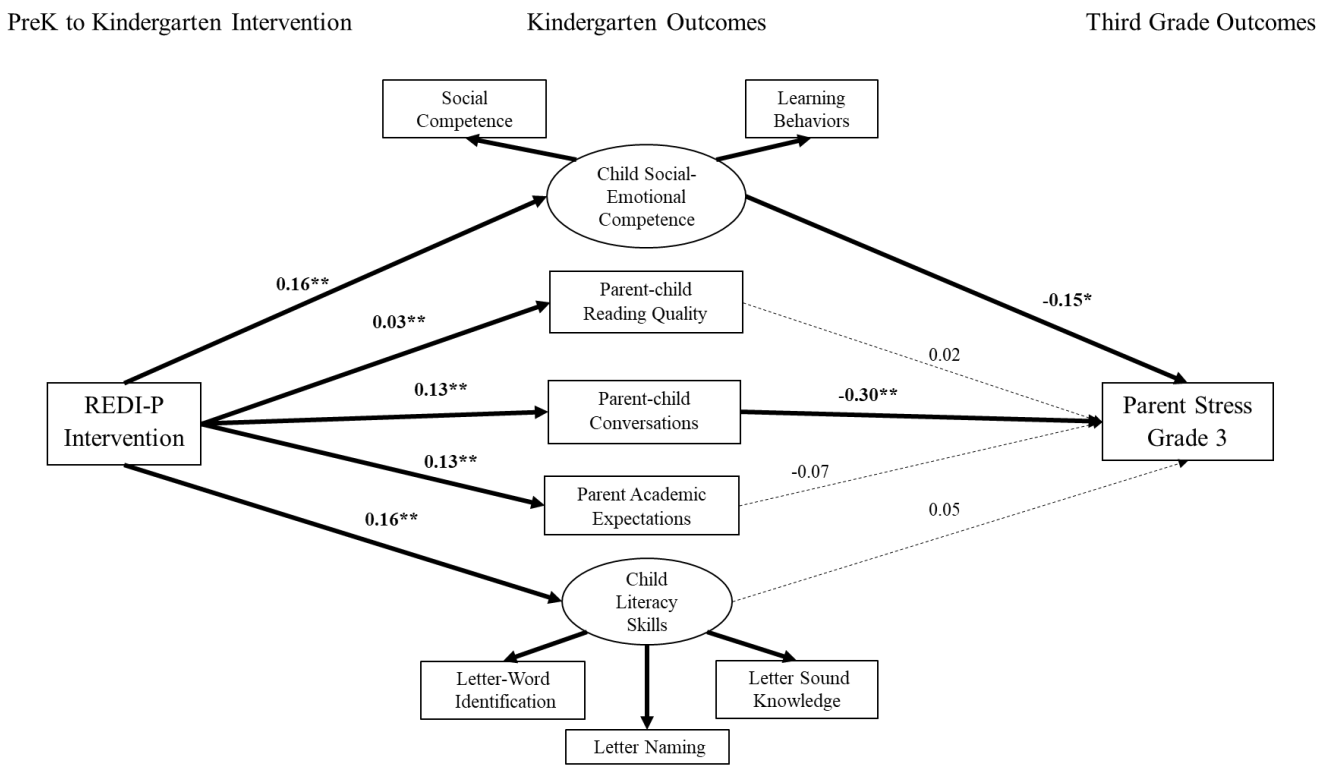

Figure 3. Model of mediated intervention effects on parenting stress in third grade using the standardized coefficients.
* $p < .05$. ** $p < .01$

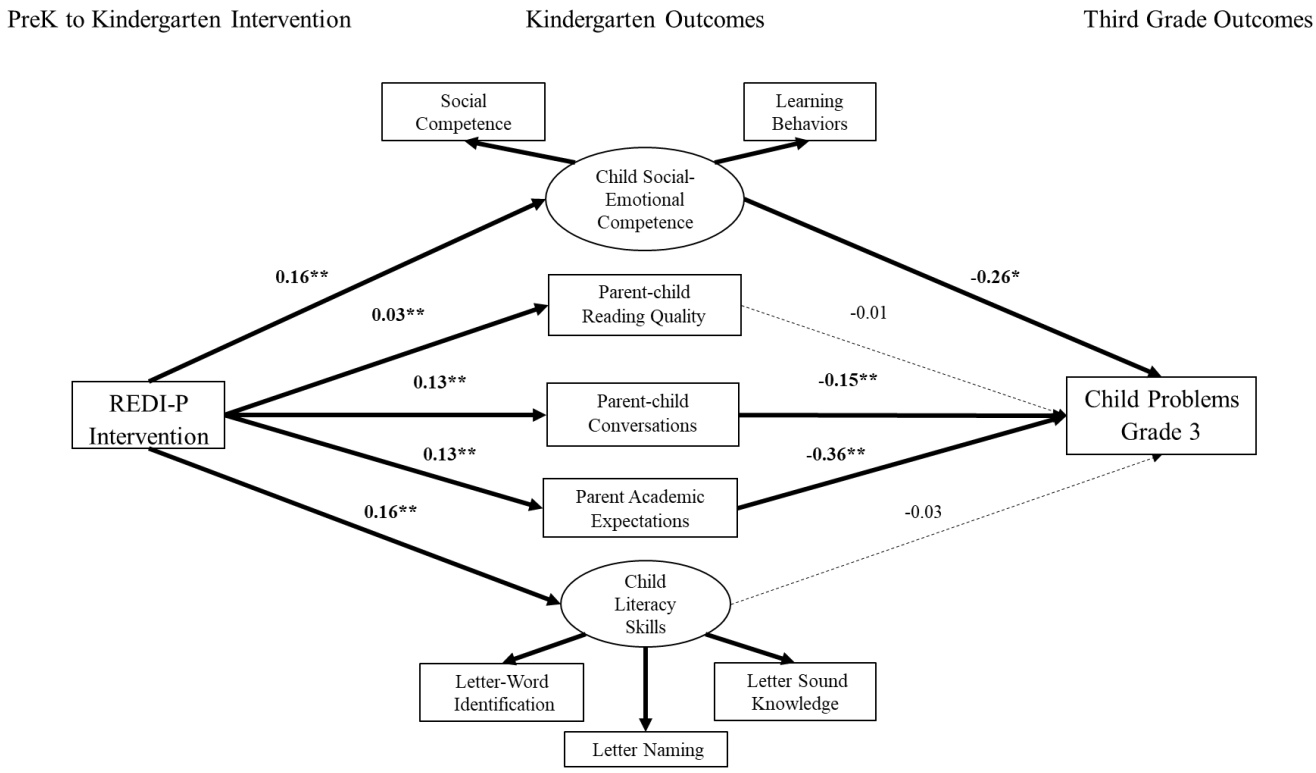

Figure 4. Model of mediated intervention effects on child problems at home in third grade using the standardized coefficients.
* $p < .05$. ** $p < .01$