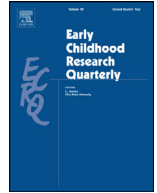




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journal homepage: [www.elsevier.com/locate/ecresq](http://www.elsevier.com/locate/ecresq)Sustained benefits of a preschool home visiting program: Child outcomes in fifth grade<sup>☆</sup>Karen L. Bierman<sup>a,\*</sup>, Brenda S. Heinrichs<sup>a</sup>, Janet A. Welsh<sup>b</sup>, Robert L. Nix<sup>c</sup><sup>a</sup> Child Study Center, The Pennsylvania State University, University Park, PA, 16802<sup>b</sup> Prevention Research Center, The Pennsylvania State University, University Park, PA, 16802<sup>c</sup> Department of Human Development and Family Studies, University of Wisconsin-Madison, Madison, WI, 53715

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## ABSTRACT

This study evaluated the sustained effects of the Research-based Developmentally Informed Parent program (REDI-P) at fifth grade, six years after intervention. Participants were 200 prekindergarten children attending Head Start (55% White, 26% Black, 19% Latinx, 56% male, mean age of 4.45 years at study initiation) and their primary caregivers, who were randomly assigned to a control group or a 16-session home-visiting intervention that bridged the preschool and kindergarten years. In addition, the study explored moderation of sustained effects by parenting risks (e.g., less than high-school education, single-parent status, parental depression, and low parent-child warmth). Growth curves over the course of the elementary years examined outcomes in three domains: child academic performance, social-emotional adjustment, and parent-child functioning. At fifth grade, significant main effects for intervention were sustained in the domains of academic performance (e.g., reading skills, academic motivation, and learning engagement) and parent-child functioning (e.g., academic expectations and parenting stress). Significant moderation by parenting risk emerged on measures of social-emotional adjustment (e.g., social competence and student-teacher relationships); parenting risk also amplified effects on some measures of academic performance and parent-child functioning, with larger effects for children from families experiencing fewer risks. Implications are discussed for the design of preschool home visiting programs seeking to enhance the school success and social-emotional well-being of children living in poverty.

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Socio-economic disadvantage creates multiple challenges for families with young children. Limited financial and educational resources, crowded living conditions, family instability, and limited access to high-quality early education programs represent common stressors that can undermine parents' abilities to provide effective learning support during early childhood (Evans, 2004). Correspondingly, children who grow up in poverty often exhibit delays in school readiness when they enter kindergarten

(Kaiser et al., 2000). These delays impede their academic success and social-emotional adjustment at school, with increasing disparities over time that reduce educational attainment and well-being (Ryan, Fauth, & Brooks-Gunn, 2006).

Public investment in preschool programming has increased substantially over the past two decades, designed to reduce socioeconomic disparities in school readiness (Phillips et al., 2017). High-quality preschool promotes child skill acquisition (Yoshikawa et al., 2013), but longer-term benefits have been disappointing. A review of 67 high-quality early interventions documented diminishing benefits for children after they transitioned into elementary school, with academic benefits reduced by half in kindergarten and then reduced by half again two years later (Bailey, Duncan, Odgers & Yu, 2017). These findings have spurred efforts to strengthen educational supports for low-income children as they transition into kindergarten to increase the sustained effects of preschool programs (Jenkins et al., 2018). Empowering parents to help teach their children at home is emerging as one valuable and underutilized strategy to achieve this important goal.

This paper reports on the effects of a parent intervention, the REDI (Research-based Developmentally Informed) Parent

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\* Corresponding author.

E-mail addresses: kb2@psu.edu (K.L. Bierman), ibc@psu.edu (B.S. Heinrichs), jaw900@psu.edu (J.A. Welsh), robert.nix@wisc.edu (R.L. Nix).

program (REDI-P), that was designed to increase the sustained benefits of enriched preschool programming by engaging parents and strengthening home learning support as children made the transition from Head Start into elementary school. Following families who were randomly assigned to the preschool parent intervention or control group, we examined the longitudinal course of child academic performance, social-emotional adjustment, and parent-child functioning through the elementary school years to evaluate benefits still evident by fifth grade, 6 years after intervention. In addition, we examined the degree to which parenting risks associated with family socio-economic disadvantage moderated the sustained benefits of the parent intervention.

## 1. Using preschool parent interventions to promote child school readiness

Recognizing that parents are a primary source of support for positive child development in the context of poverty, Head Start has long sought to empower parents with home visits designed to enhance their parenting skills and support family well-being (Manz, 2012). An emerging set of studies suggests that parent interventions may play a particularly important role in promoting school adjustment as children make the transition into kindergarten (Brotman et al., 2013; Ford, McDougall, & Evans, 2009; Welsh, Bierman, & Mathis, 2014). In general, preschool parent interventions have used two approaches to promote child school readiness, including efforts to: 1) increase home learning support to boost child academic skill acquisition, or 2) enhance parent-child relationships and improve positive behavioral supports at home to promote child self-regulation and social-emotional skill development.

### 1.1. Boosting academic school readiness skills

A growing evidence base suggests that parents can effectively promote oral language and emergent literacy skills when they are provided with scaffolded parent-child learning activities and guided in optimal instructional strategies. For example, home-based interactive reading programs have effectively taught parents to ask questions and use descriptive expansions when reading with their children, producing significant increases in receptive and expressive language skills (see reviews by Manz, Hughes, Barnabas, Bracaliello, & Ginsburg-Block, 2010; Mol, Bus, DeJong, & Smeets, 2008; Reese, Sparks, Leyva, 2010). Similarly, providing parents with strategically selected play activities has strengthened children's letter identification and letter-sound knowledge (Evans & Shaw, 2008). These kinds of parent interventions may enhance school success by boosting child skills at school entry and thereby setting them on a more positive future trajectory of learning and achievement. For example, developmental studies suggest that print knowledge and phonemic awareness promote early reading success (Catts, Fey, Zhang & Tomblin, 1999; Senechal & LeFevre, 2002), and oral language skills support interpersonal communication and comprehension, thereby fostering productive learning engagement at school entry (Ramsook, Welsh, & Bierman, 2020).

### 1.2. Enhancing positive parent-child relationships

A second common approach to preschool parent intervention focuses on increasing positive parenting skills, promoting parent-child communication and increasing positive behavioral supports at home (see Webster-Stratton & Taylor, 2001 for a review). These interventions may promote school adjustment by fostering children's self-regulation and social-emotional skills, helping children follow school rules, participate effectively in classroom activities,

form positive peer relationships, and control problem behaviors (Brotman et al., 2013; Webster-Stratton, Reid, & Hammond, 2001).

### 1.3. The REDI parent program

These two intervention approaches were combined in the REDI-P program which was designed to complement and extend the impact of the REDI classroom program delivered by Head Start teachers (see Bierman et al., 2008, for details). During 10 home visits scheduled in the spring of the prekindergarten year, REDI-P provided parents with home learning activity kits containing stories, parent-child dramatic play activities, conversation-based games, and literacy activities. In order to support child social-emotional learning, the content of REDI-P stories and parent-child activities was designed to foster conversation about the social-emotional skills introduced in the REDI classroom program, emphasizing cooperation, caring, compliments, emotional understanding, and self-control. Stories included embedded questions to help parents read interactively, and parent-child activities facilitated practice in letter and letter-sound identification (for more details, see Bierman, Welsh, Heinrichs, Nix, & Mathis, 2015). Home visitors used modeling videotapes, discussion, and reflection activities to coach parents in the optimal use of these materials and associated positive parenting strategies. In addition, REDI-P included six home visits scheduled between August and October of the kindergarten year, designed to further support for learning at home and encourage home routines associated with school attendance and performance.

Children who received REDI-P along with the REDI classroom program showed significantly better early literacy skills, academic performance, and social competence in kindergarten, with average scores roughly one-fourth of a standard deviation higher than children in the randomized control group who received the REDI classroom program alone (Bierman et al., 2015). These findings confirmed the short-term value of REDI-P in boosting child school readiness and enhancing kindergarten adjustment.

## 2. Can preschool parent interventions reduce fade out and produce long-term benefits?

A growing body of evidence from REDI-P and other programs demonstrates that preschool parent interventions can improve child school readiness (Brotman et al., 2013; Ford et al., 2009; Mol et al., 2008; Webster-Stratton, Reid, & Hammond, 2001). However, few studies have included multi-year follow-up assessments to determine whether preschool parent intervention effects fade out over time as do many preschool classroom intervention effects.

Conceptually, it stands to reason that preschool parent interventions could have longer-lasting benefits than preschool classroom interventions alone. Researchers have speculated that the benefits from preschool classroom interventions fade out because of the discontinuity between preschool and kindergarten, which creates a lack of aligned and sustained support in elementary school for the child skills that received a boost from preschool intervention (Jenkins et al., 2018). Whereas children complete their preschool programs and transition to new school settings, they remain with their parents across the transition, giving parents the opportunity for sustained influence. Parent who receive intervention as children transition into elementary school may continue to provide positive support for their children's learning after the intervention ends, thus sustaining children's gains over time. Parenting skills and parent-child relationships that were enhanced by intervention at school entry may also buffer children and families from subsequent stressors, thereby preventing – or reducing – the emergence of future adjustment difficulties (Sandler et al., 2011; Webster-Stratton & Taylor, 2001).

Interventions may also fade out when kindergarten teachers emphasize the same skills as those targeted in preschool, helping children who did not receive preschool intervention catch up with their peers (Bailey, Duncan, Odgers, & Yu, 2017). In contrast, parent-focused school readiness programs target parenting skills that fit the “trifecta” criteria linked with increased likelihood of sustained impact (Bailey et al., 2017). First, as evident in the research cited above, parenting skills are malleable and respond to intervention. Second, without intervention, parents are unlikely to substantially increase support for learning as children enter school. In fact, longitudinal studies reveal normative declines in parent involvement when children enter formal schooling (Rimm-Kaufmann & Pianta, 1999). Without intervention, parents typically decrease support for child learning at home as children enter kindergarten and move forward into subsequent grades (Powell, Son, File, & Froiland, 2012). Third, effective parent involvement and support for learning make fundamental contributions to children’s school success. When families provide high levels of support for learning during the transition into elementary school, children show heightened academic gains and social competence along with reduced behavior problems at school (El Nokali, Bachman, & Votruba-Drzal, 2010; Powell et al., 2012).

The few preschool parent intervention studies that have included follow-up assessments in elementary school support expectations for sustained effects. For example, Brotman and colleagues (2016) followed participants of the ParentCorps prekindergarten parenting program and found sustained benefits in areas of child academic performance and mental health three years later, when children were in second grade. Similarly, children who participated in the intervention studied here, REDI-P, showed sustained effects in areas of child academic performance, social-emotional skills, and parent-child functioning (e.g., reduced parenting stress, and fewer child problems at home) in third grade (Bierman et al., 2018). Given that follow-up studies of preschool programs show diminishing benefits over time as children proceed through elementary school (Bailey et al., 2017), it is important to understand whether the effects of parent interventions are still evident at the end of elementary school.

### 3. Potential variation in sustained effects

As noted above, low income families often face multiple challenges that can undermine their ability to provide effective learning support in early childhood (Books-Gunn & Markman, 2005; Evans, 2004). These risk factors may attenuate parent engagement in interventions that, like REDI-P, require the investment of significant time and effort in child-focused learning activities. For example, socioeconomic disadvantage and single-parent status diminished intervention benefits in a meta-analysis of parent training programs (Lundahl, Risser, & Lovejoy, 2006). Similarly, socioeconomic disadvantage and low levels of parent education reduced intervention effects in a meta-analysis of interactive reading programs (Mol et al., 2008). In parenting interventions designed to enhance child adjustment in the early school years, lower levels of parent education (Sheridan, Knoche, Kupzyk, Edwards & Marvin, 2011) and maternal depression (Baydar et al., 2003; Nix, Bierman, McMahon, & the Conduct Problems Prevention Research Group, 2009) have reduced intervention engagement. In addition, parents may be less interested in or less able to implement a parenting intervention when they have a less warm or more conflictual relationship with their child (Nix et al., 2009).

These risk factors may also reduce parents’ post-intervention abilities to sustain parenting skills and remain actively engaged in supporting child school success as children progress through elementary school. Prior studies suggest that parents with low levels of education often feel unprepared to support their children’s edu-

cation, contributing to lower academic expectations for their children and less efficacy regarding their ability to promote school success (Bandura, Barbaranelli, Caprara, & Pastorelli, 2001; Sénéchal & LeFevre, 2002). Longitudinal studies suggest that the disadvantages experienced by single-parent families relative to two-parent families (e.g., lower standard of living, higher stress levels, less effective parenting) have cumulative effects on child adjustment and educational achievement over time (Amato, 2005). Similarly, maternal depression appears to undermine effective parenting and support for learning with cumulative effects on child adjustment over time (Baker & Iruka, 2013; Feder et al., 2009).

When multiple risk factors occur together, their impact can be especially serious (Evans, Li, & Whipple, 2013). Although risk factors are often related to one another, their effects may not be redundant. Seminal research in this area has demonstrated nonlinear, multiplicative, and threshold effects (Rutter, 1979; 2001).

Pivotal research has demonstrated that the total number of risk factors may be more predictive of adverse outcomes than the presence of any particular risk factor and, in some cases, more predictive than all of the individual risk factors that comprise it entered separately (Hooper, Burchinal, Roberts, Zeisel, & Neebe, 1998). In addition, the use of a cumulative risk index has methodological advantages, as it avoids the collinearity among risk factors that emerge when multiple risk factors are entered as single, co-existing risks (Evans et al., 2013). Cumulative risk indices appear especially useful when hypotheses about the differential effects of each particular risk factor are underdeveloped (Burchinal, Roberts, Hooper, & Seizel, 2000).

### 4. The present study

This study examined the elementary school follow-up assessments of children who participated in the REDI parent intervention study when they were attending Head Start preschools and transitioning into kindergarten. Study participants were recruited from Head Start classrooms that were using the REDI classroom program and hence all participants (intervention and control groups) received enriched preschool programming. After enrolling in the intervention program, families were randomly assigned (at the individual level, within classrooms) to receive the REDI-P home visiting program (intervention group) or to receive an alternative set of simple math activities in the mail (control group).

The analyses tracked outcomes for children and parents in the intervention and control groups using five waves of data collected from the end of kindergarten through the end of fifth grade. Outcome measures represented three domains of adjustment: academic performance, social-emotional competence, and parent-child functioning. Data were analyzed using growth curve models in order to explore trajectories of measured outcomes over time and evaluate the sustained effects of the intervention. In addition, this study evaluated the degree to which parenting risk factors associated with socio-economic disadvantage (e.g., low levels of parent education, single parent status, parent depression, and low parent-child warmth) moderated the sustained benefits of the home visiting intervention.

Research questions included the following: (a) How did child and parent outcomes change across the school years and were these trajectories different for intervention and control groups? and (b) Were differences in the intervention and control group trajectories moderated by the level of parenting risk factors present at the time of intervention delivery in preschool?

It was hypothesized that children in the REDI-P intervention group would exhibit more positive trajectories over time in all three domains relative to children in the control group. It was further hypothesized that intervention benefits would be moderated by the number of parenting risks present at the time of

intervention delivery, such that children whose parents experienced more parenting risk factors would show diminished benefits relative to children whose parents experienced fewer risk factors.

## 5. Method

Over two successive years, participants were recruited from 24 Head Start centers serving three counties in Pennsylvania. Preschool classrooms in all of the centers were implementing the REDI classroom program. Letters were sent home with the children describing the study, and families who indicated interest were contacted by project staff members to arrange home visits where the study was fully explained, informed consent was obtained, and pre-intervention (baseline) assessments were completed. Overall, 52% of the eligible families ( $N = 299$ ) indicated interest in the study. However, some families were deemed ineligible ( $n = 35$ ), primarily because the child was unlikely to transition into kindergarten in the fall or, in some cases, because the child was identified with special needs or did not speak English. Recruitment ceased once all available study slots were filled. Because randomization occurred at the individual family level, each Head Start classroom included children from the intervention and control condition. All research procedures followed the ethical guidelines of the American Psychological Association and were approved by the university Institutional Review Board.

### 5.1. Participants

Participants included 200 children ( $n = 95$  intervention,  $n = 105$  control, 55% White, 25% Black, 20% Latinx, 55% male), mean age of 4.45 years old ( $SD = .29$ ) at study entry. Consistent with Head Start eligibility criteria, most participating families lived in poverty with a median annual income of \$18,000; 54% were unemployed. Most parents had completed high school (66%), although 16% had not completed high school, 21% had attained a 2-year degree or technical certificate, and 4% had a 4-year college degree. Many were co-parenting (39% were married; 25% were living with a committed partner) and 36% were single parents.

Children were followed longitudinally as they left Head Start and dispersed widely into 74 elementary schools and 149 kindergarten classrooms. Annual assessments were conducted in the spring of kindergarten, first grade, second grade, third grade and fifth grade (no data were collected in fourth grade). Sample attrition averaged a little less than 3% per wave, virtually all due to family moves and inability to locate families, with a retention rate of 81% in fifth grade. T-tests comparing the family demographics and baseline scores of retained and attrited participants revealed no differences in family demographics or any variable used in this study. (A diagram illustrating participant flow is provided in Figure S1 and results of comparisons between retained and attrited samples are provided in Table S1 in supplementary materials.)

### 5.2. Intervention

The REDI-P intervention involved a series of 16 home visits – 10 scheduled during the spring semester of the prekindergarten year and six scheduled in the fall after the child's transition into kindergarten. The intervention was manualized, and included a protocol of reflection questions, discussion topics, and skill reviews for each session. Central to the intervention were REDI activity boxes of play materials and stories for parents and children to use at home, designed to promote child skills in the dual areas of language-emergent literacy skills (e.g., letter identification, letter-sound associations, and oral language) and social-emotional skills (e.g., cooperation, emotion regulation, and self-control). These included stories featuring social-emotional themes (e.g., feelings, sharing,

and caring), scripted with embedded questions to support interactive reading and parent-child conversation. Dramatic play activities included embedded literacy activities. 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. Each session began with a check-in to encourage parental self-reflection and ended with personalized goal setting. Home visitors reviewed the home learning activities each session and discussed optimal parenting strategies. Parenting tips were illustrated with videotapes and featured parent-child conversation and positive behavioral support for learning (e.g., specific praise, emotion coaching, and collaborative problem-solving).

Six home visitors with training in early education or human services were recruited from the participating communities. The home visitors attended five-day training workshops and participated in weekly group and individual phone calls with the intervention supervisor. 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 home visitors. Sixteen percent of the intervention families reported that Spanish was spoken in the home; all 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 78% of the 16 planned home visits ( $M = 12.42$ ). Most parents also made regular use of program home learning materials between sessions, according to home visitor ratings ( $M = 2.27$  out of 3). Further analyses of these ratings suggested a high level of use for 38% of the families (e.g., most of the materials being used several times per week, mean rating 2–3 out of 3), a moderate level of use of the materials for 49% of the sample (e.g., some of the materials being used some of the time during the week, mean rating 1–2), and little to no use of the materials for 13% of the sample (e.g., mean rating 0–1).

Control group families received 4 packages of alternative learning materials to use at home (simple math-focused activities) delivered monthly.

### 5.3. Assessment procedures and study measures

Most outcome measures were collected at each of the five assessment waves, although a few were collected less often as noted below. At each assessment, trained research assistants visited homes to interview parents and visited schools to observe children and deliver teacher ratings, which were completed independently and returned to the project. Research assistants and all teachers were naïve concerning the intervention-control group status of children and families. Teachers and parents were compensated financially for completing assessments.

#### 5.3.1. Academic domain

Teachers provided ratings of child academic performance in reading/language arts and academic motivation at three waves (second, third, and fifth grades) using the *Academic Competence Evaluation Scales* (DiPerna & Elliott, 1999). Eleven items scored on a 5-point scale (1 = far below grade level to 5 = far above grade level) described reading competence (e.g., comprehension, word-attack skills, and reading fluency) and more general language arts skills (e.g., oral and written communication skills;  $\alpha = .97$  –  $.98$  across years). Another 11 items scored on a 5-point scale (1 = Never to 5 = Almost always) described academic motivation (e.g., is motivated to learn; persists when task is difficult;  $\alpha = .97$  –  $.98$  across years). Average item ratings were used in analyses.

Learning engagement was assessed by the research assistants who spent time with children at each of the five waves, administering interview items and other learning tasks. After each assessment session, these examiners rated children using a revised 13-item version of the *Adapted Leiter-R Assessor Report* (Smith-Donald, Raver, Hayes, & Richardson, 2007). Items were rated on a 4-point scale (1 = not much to 4 = very much) and described focused and engaged learning behaviors (e.g., pays attention to instructions; sustains concentration;  $\alpha = .89 - .91$  across years).

### 5.3.2. Social-emotional domain

Teachers rated the social competence of children at each of the five assessment waves using the 13-item *Social Competence Scale* (Conduct Problems Prevention Research Group, 1995). Items were rated on a 6-point scale (1 = almost never to 6 = almost always) and assessed prosocial behaviors (e.g., listens to others' points of view) and emotion regulation (e.g., copes well with disappointment;  $\alpha = .92-.94$  across years).

Teachers also rated their relationship with the child each year using 16 items from the *Student-Teacher Relationship Scale* (Pianta, 2001). Items were rated on a 5-point scale (1 = definitely does not apply to 5 = definitely applies) and described closeness (e.g., "I share an affectionate, warm relationship with this child,") and conflict (e.g., "This child easily becomes angry with me" [reverse coded],  $\alpha = .90 - .94$  across years).

### 5.3.3. Parent-child domain

One intervention goal was to increase parent confidence in their ability to support their child's school adjustment and attainment. Their positive beliefs in this regard were assessed at each assessment wave with two items reflecting their expectations regarding their child's future academic success: "Knowing your child as you do, how far do you think she or he will go in school?" (Yamamoto & Holloway, 2010) and "Knowing your child as you do, what is the average grade you expect him/her to receive in school?" (Phillipson & Phillipson, 2007). Each item was rated on a 6-point scale (1 = 11<sup>th</sup> grade to 6 = more than four years of college and 1 = lower than Cs to 6 = As, respectively,  $\alpha = .66 - .75$  across years).

Parents also rated their parenting stressors using a sub-set of the nine highest-loading items on the Childrearing Stress subscale from the *Parenting Stress Index* (Abidin, 1995). Items were rated on a 5-point scale (1 = strongly disagree to 5 = strongly agree) and reflected distress about the parent-child relationships (e.g., "When I do things for my child, I get the feeling that my efforts are not appreciated very much" and "I expected to have closer and warmer feelings for my child than I do, and this bothers me,"  $\alpha = .80 - .88$  across years.)

Finally, parents rated child problems at home using 20 items from the *Strengths and Difficulties Questionnaire* (Goodman, 1997). Items were rated on a 3-point scale (0 = not true to 2 = certainly true) and reflected emotional symptoms (e.g., often unhappy, depressed, or tearful), peer problems (e.g., gets along better with adults than with other children), conduct problems (e.g., often fights with other children or bullies them) and hyperactivity (e.g., easily distracted, concentration wanders;  $\alpha = .84 - .87$  across years).

### 5.3.4. Parenting risk

A central goal of this study was to examine parenting risks as a moderator of the sustained benefits of the REDI-P intervention. A parenting risk measure was constructed at baseline using family characteristics that predicted decreased parent engagement in REDI-P and reduced use of the home activities during intervention (Nix et al., 2018). These included low parent education (e.g., did not graduate from high school or earn a GED; 16% of the sample),

single parent (e.g., not married and without a committed partner; 36% of the sample), depression (e.g., above the clinical cut-off on the self-rated *Center for Epidemiological Studies-Depression Scale* [Radloff, 1977]; 36% of the sample), and low parent-child warmth (e.g., below average levels of observed warmth shown toward child as assessed with the *Post-Visit Inventory* [Dodge, Bates, & Pettit, 1990]; 44% of the sample). These four parenting risks were combined in a cumulative risk index, with scores of 0 risks (26% of the sample), 1 risk (32% of the sample), 2 risks (28% of the sample), or 3 - 4 risks (14% of the sample).

### 5.3.5. Baseline covariates

Several baseline variables collected in the fall of the Head Start year were included as covariates to increase the precision of parameter estimates. In addition to the baseline measure of the outcome being analyzed, covariates include child sex, age, and race, as well as two measures of child cognitive development: Applied Problems (from the *Woodcock-Johnson-III: Tests of Achievement*; Woodcock, 2001) and Block Design (from the *Wechsler Preschool and Primary Scale of Intelligence - III*; Wechsler, 2002). Means and standard deviations for these covariates are provided in Table S2 in the supplementary on-line materials, separately for the intervention and control groups.

## 5.4. Plan for analyses

The sustained effects of the REDI-P intervention were evaluated with separate growth curves for each outcome across the five waves of elementary school data. Because random assignment to intervention and control conditions occurred within classrooms and because the intervention took place completely outside the classroom context, nesting children within Head Start classrooms was not necessary; intraclass correlation coefficients at the classroom level for all outcomes were not statistically significant and negligible by the beginning of this study, when children were in kindergarten. The wide dispersion of children across elementary schools and classrooms following the kindergarten transition also made elementary school nesting unnecessary. Hence, two-level hierarchical linear models, nesting assessment waves within children, with random intercepts and random slopes were estimated (Singer & Willet, 2003).

At Level 1, models included linear, quadratic, and cubic specifications of time, starting at post-intervention assessments in the kindergarten year (or second grade for some outcomes) and continuing through fifth grade. These models describe the nature of change across time for each outcome. If growth is constant during elementary school, the model only needs a linear effect of time to summarize the data. However, if the rate of growth slows down or speeds up during elementary school, the model requires both a linear and quadratic effect of time. If growth ever changes directions (from faster to slower or the reverse), the model requires linear, quadratic, and cubic effects of time (for a more complete description of non-linear growth curve models, see Grimm, Ram, & Hamagami, 2011). At Level 2, models included the fixed effects of intervention status and the baseline covariates, including the pre-intervention measure of the outcome, study design features of cohort and county site, child demographics of sex, race, age, and measures of child cognitive development. The intercept was centered at fifth grade so it represented a point estimate of the sustained effects of the intervention. Differences between children in the intervention and control groups at the end of elementary school are presented as Cohen's *d*, which represents a proportion of a standard deviation, adjusted for study covariates.

To examine whether growth over time was similar for children from the intervention and control groups, interaction terms

**Table 1**  
Means and standard deviations of fifth grade outcomes and correlations with initial parenting risks.

Variables	Mean	(SD)	1	2	3	4	5	6	7	8
<u>AcademicOutcomes</u>										
1. Reading Skills (T)	2.57	(0.85)								
2. Academic Motivation (T)	2.53	(0.92)	0.77							
3. Learning Engagement (O)	3.63	(0.35)	0.21	0.24						
<u>Social-EmotionalOutcomes</u>										
4. Social Competence (T)	4.09	(0.96)	0.40	0.59	0.20					
5. Teacher Relationship (T)	4.02	(0.67)	0.31	0.52	0.13	0.69				
<u>Parent-childOutcomes</u>										
6. Academic Expectations (P)	4.04	(1.12)	0.53	0.51	0.12	0.26	0.23			
7. Parenting Stress (P)	1.92	(0.71)	-0.18	-0.28	-0.20	-0.27	-0.15	-0.29		
8. Child Problems (P)	10.99	(6.32)	-0.33	-0.41	-0.27	-0.26	-0.21	-0.38	0.61	
InitialParentingRisks	1.72	(0.99)	-0.02	-0.18	0.07	-0.23	-0.21	-0.02	0.23	0.19

Note: T = teacher rated, O = observer rated, P = parent rated, SD = standard deviation.  
All correlations greater than or equal to .18 are statistically significant,  $P < 0.05$ .

were computed between intervention status and each specification of time (e.g., linear, quadratic, and cubic). To examine whether growth curves were affected by initial parenting risk, interaction terms were computed between intervention status and the cumulative index of parenting risk, as well as the three-way interaction between intervention status, parenting risk, and each specification of time. The continuous parenting risk index was used to compute these interaction terms; to illustrate the results, we present contrasts in intervention effect sizes for families with low parenting risk (no risk factors) and families with elevated risks (2 risk factors). Guided by Bayesian and Akaike information criterion and substantive knowledge of the domain, models were trimmed of non-significant and/or seemingly spurious higher-order interaction terms to yield more parsimonious and stable estimates of parameters of interest. These analyses were conducted with proc mixed in SAS 9.4, which uses full-information maximum likelihood procedures to reduce bias associated with data that are missing at random.

## 6. Results

Descriptive statistics for fifth-grade outcomes and the initial parenting risk measure are presented in Table 1. Adjusted means and standard errors for intervention and control groups at each grade level are shown in Table S3 in supplementary on-line materials.

Within domain, teacher ratings were highly correlated,  $r = 0.77$  for reading skills and academic motivation, and  $r = 0.69$  for social competence and student-teacher relationship. Similarly, parent ratings of parenting stress were strongly correlated with their ratings of child problems,  $r = 0.61$  and moderately (inversely) correlated with their academic expectations,  $r = -0.38$ . Correlations across outcome domains were moderate for the same rater but statistically significant, ranging from  $r = 0.31$  to  $r = 0.59$  for teacher ratings in the academic and social-emotional domains. Correlations across domain were generally small for different raters with the exception of teacher-rated academic performance and parent academic expectations which ranged from  $r = 0.51$  to  $r = 0.53$ . Children in families that scored higher on initial parenting risks had significantly lower teacher-rated academic motivation, social competence, and student-teacher relationships in fifth grade than children experiencing fewer parenting risks,  $r = -0.20$  to  $r = -0.24$ , and their parents reported significantly higher levels of parenting stress and child problems,  $r = 0.23$  and  $r = 0.22$ , respectively.

### 6.1. Outcomes in the academic domain

Results for the growth curve models are presented in Table 2, with the academic domain outcomes listed first. As shown in

Fig. 2, teachers rated the grade level reading skills of children in this sample as gradually declining between second and fifth grades. In other words, compared to grade expectations and the relative performance of their classmates, the children in this sample, all of whom had been in Head Start during preschool, were falling further behind over time. However, a significant intervention effect was sustained at the fifth-grade intercept,  $d = 0.23$ ,  $P = 0.04$ , representing almost one-quarter of one standard deviation, as children in the intervention group continued to perform at a higher level in reading and language arts than children in the control group. Being in the REDI-P program helped arrest the increasing educational disparities children in poverty experienced over time. There was also significant interaction between intervention status and parenting risk, whereby children from families with lower levels of risk were most likely to experience sustained benefits from the intervention, with an effect size for children from families with no parenting risks of  $d = 0.34$ , statistically significant and representing about one-third of a standard deviation, compared to the effect size for children from families with two risks of  $d = 0.08$  and nonsignificant.

Parallel to teacher-rated reading skills and shown in Table 2 and depicted in Fig. 2, intervention effects on teacher-rated academic motivation were stable over time from second to fifth grade and showed a significant sustained intervention effect at the fifth-grade intercept,  $d = 0.20$ ,  $P = 0.05$ . This effect was not moderated by initial parenting risk.

As summarized in Table 2 and depicted in Fig. 3, observer-rated learning engagement showed a more complex growth pattern over time, and children in the intervention and control groups demonstrated different patterns of development (as reflected by a significant intervention status by time interaction term). A significant intervention effect emerged over time, resulting in a significant intervention effect at the fifth-grade intercept,  $d = .43$ ,  $P = 0.003$ . Whereas children in the control group declined in learning engagement between third and fifth grade, children in the intervention group showed stable levels of learning engagement. This effect was not moderated by initial parenting risk.

### 6.2. Outcomes in the social-emotional domain

Results for the growth curve model of teacher ratings of student social competence and student-teacher relationships, are presented in the middle rows of Table 2 and illustrated in Fig. 4. Both outcomes showed stable declining trajectories over time, and neither showed a significant sustained intervention effect at the fifth-grade intercept ( $P > 0.10$ ). However, for both of these measures, there was a significant moderated intervention effect. Receiving REDI-P had positive and sustained benefits in social-emotional functioning for children in families with low levels of parenting risk. For

**Table 2**  
Summary of growth curves and REDI-P intervention effects.

Outcomes	Effects of Time			Intervention Effects on Time			5 <sup>th</sup> Gr. Intervention Main Effects		5 <sup>th</sup> Gr. Intervention Moderated Effects
	Linear	Quadratic	Cubic	Linear	Quadratic	Cubic	Coefficient	Effect Size	Coefficient
<u>AcademicDomain</u>									
Reading Skills	-0.06** (0.02)						0.20* (0.10)	0.23*	-0.26* (0.12)
Academic Motivation	-0.03... (0.02)						0.19* (0.10)	0.21*	
Learning Engagement	-0.22** (0.06)	-0.13** (0.03)	-0.02** (0.00)	0.04** (0.01)			0.15** (0.05)	0.44**	
<u>Social-EmotionalDomain</u>									
Social Competence	-0.04*. (0.02)						0.06 (0.09)	0.07	-0.19* (0.09)
Teacher Relationships	-0.06** (0.01)						0.06 (0.06)	0.10	-0.17** (0.06)
<u>Parent-childDomain</u>									
Academic Expectations	0.16.. (0.11)	0.17** (0.05)	0.02** (0.01)				0.33* (0.15)	0.29*	-0.20* (0.10)
Parenting Stress	0.04** (0.01)						-0.19* (0.10)	0.27*	
Child Problems	-1.32 (1.53)	-1.05 (0.99)	-0.17 (0.16)	5.55* (2.19)	3.71** (1.42)	0.58* (0.23)		0.11	

Note: Standard errors are in parentheses under each coefficient. The effect size is assessed at the fifth-grade intercept and is equivalent to Cohen’s *d*. Moderator is parenting risk score. Coefficients are shown for models refined to optimize model fitting criteria. The model for reading skills also included a significant linear moderator by time interaction not shown in this table.

\*\* *P* < 0.01, \* *P* < 0.05.

families with no parenting risks, there were significant intervention-control group differences in social competence at the fifth-grade intercept, *d* = .31, *P* < 0.05, and in student-teacher relationships, *d* = .41, *P* < 0.005. In contrast, there were no significant differences in the social competence or student-teacher relationship outcomes of intervention and control groups for families with 2 initial parenting risks, *d* = .08 and *d* = .09, respectively.

### 6.3. Outcomes in the Parent-child Domain

Growth curve results for the three measures in the parent-child functioning domain are shown in the bottom three rows of Table 2 and illustrated in Fig. 5. Parent academic expectations showed a complex growth pattern over time, peaking at first grade and then flattening out by third grade. The intervention effect tended to grow larger over time, as the control group declines through fifth grade and the intervention group remains stable, resulting in a significant intervention effect at the fifth-grade intercept, *d* = .33, *P* = 0.03. This effect was moderated by initial parenting risk, with significant intervention benefits strongest for families with no initial parenting risk, *d* = .52, compared to nonsignificant benefits for children from families with 2 parenting risks, *d* = .16.

The growth curve of parenting stress revealed that intervention and control group families tended to diverge over time as stress increased for the control group but remained more stable for the intervention group, resulting in a significant difference at the fifth-grade intercept, *d* = -.19, *P* = 0.05, with no moderation by initial parenting risk.

Finally, the growth curve of parent-reported child problems showed a complex growth pattern over time, with intervention and control group children diverging over time. Although a significant intervention effect was evident at third grade (as previously reported in ), the intercept at fifth grade no longer showed a significant intervention effect, *d* = 0.11, *P* > 0.10. This effect was not moderated by initial parenting risk.

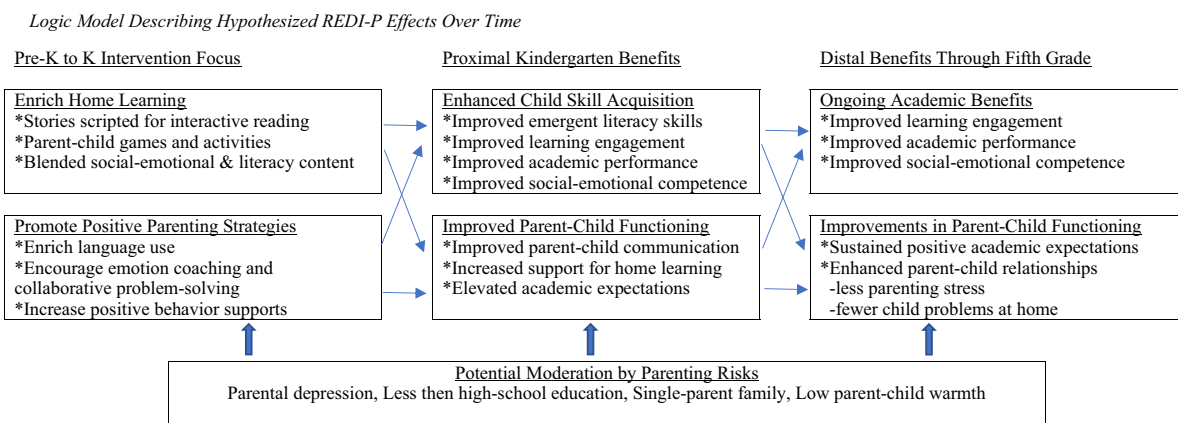
## 7. Discussion

The REDI-P home visiting program implemented during children’s preschool to kindergarten transition had benefits for children and families evident through the end of elementary school. The intervention had significant main effects on children’s academic performance (e.g., reading skills, academic motivation, and learning engagement) and parent-child functioning (e.g., parent academic expectations and parenting stress). Benefits were concentrated among families who experienced fewer parenting risks on two of these measures (e.g., reading skills and parent academic expectations). The intervention also had moderated effects on children’s social competence and student-teacher relationships, evident only among families experiencing fewer initial parenting risks.

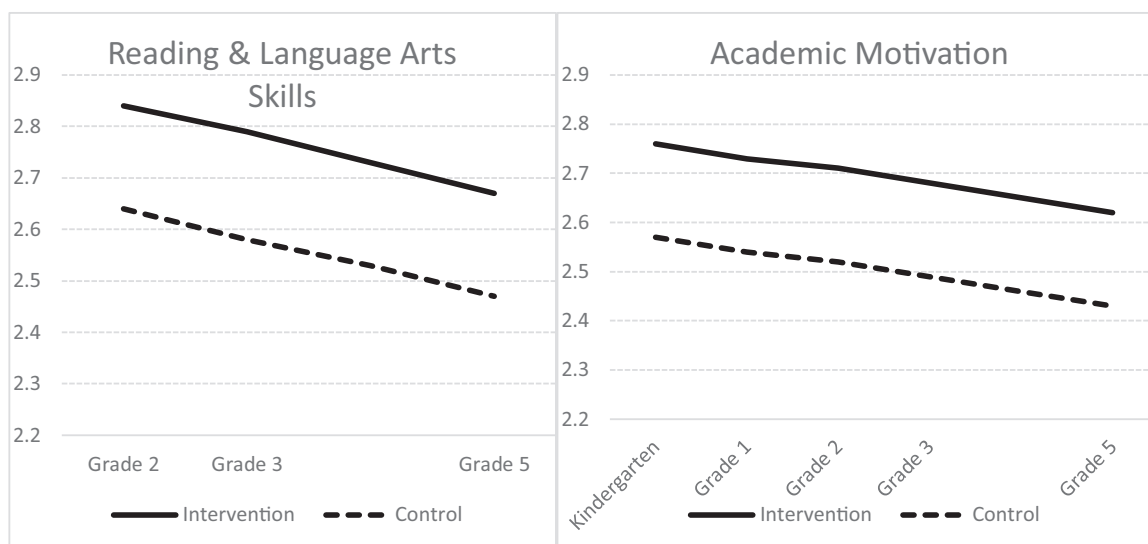
REDI-P is one of very few studies to examine the longer-term impact of a preschool parent intervention. Several aspects of the study design created a unique opportunity to explore the temporal course of child adjustment and how that course was affected by the REDI-P intervention. This study used a randomized-controlled design in which all children received enriched preschool programming, making this a rigorous study of the longer-term benefits of adding parent intervention to a center-based program (relative to receiving the center-based program alone). Regular assessments in multiple adjustment domains conducted over six years following intervention supported growth models that illuminated longitudinal trends in child adjustment over the course of elementary school and suggested that varied processes might account for different patterns of sustained intervention effects.

### 7.1. Exploring the longitudinal impact of preschool parent interventions

Conceptually, the effects of an early childhood parent intervention might unfold over time in different ways (Bailey et al. 2017; Sandler et al., 2011). Short-term interventions that boost child skills might place children on more positive trajectories as they enter school, giving them an advantage that is sustained over time.



**Fig. 1.** Logic model describing hypothesized REDI-P effects over time.



**Fig. 2.** Intervention effects on teacher-rated reading skills and academic motivation. Note: Predicted values are average item ratings derived from the growth curve models across second, third, and fifth grades, adjusted for covariates.

Improvements in parenting skills and parent-child relationships might allow families to cope more effectively with new childrearing challenges that emerge over time, preventing or reducing future maladjustment. In addition to sustained effects within one domain, cross-domain influence may also occur across time.

Measures of reading skills, academic motivation, social competence, and student-teacher relationships suggested that this sample of children living in poverty showed gradual declines in academic performance and social adjustment over the course of elementary school, consistent with prior research documenting increasing socioeconomic disparities over time (Ryan et al., 2006). Intervention and control group trajectories were parallel for measures of reading skills and academic motivation, with the boosts in child performance that were evident post-intervention in kindergarten remaining stable. This pattern of effects suggests that the gains children made during intervention allowed them to start elementary school with better skills which were sustained over time.

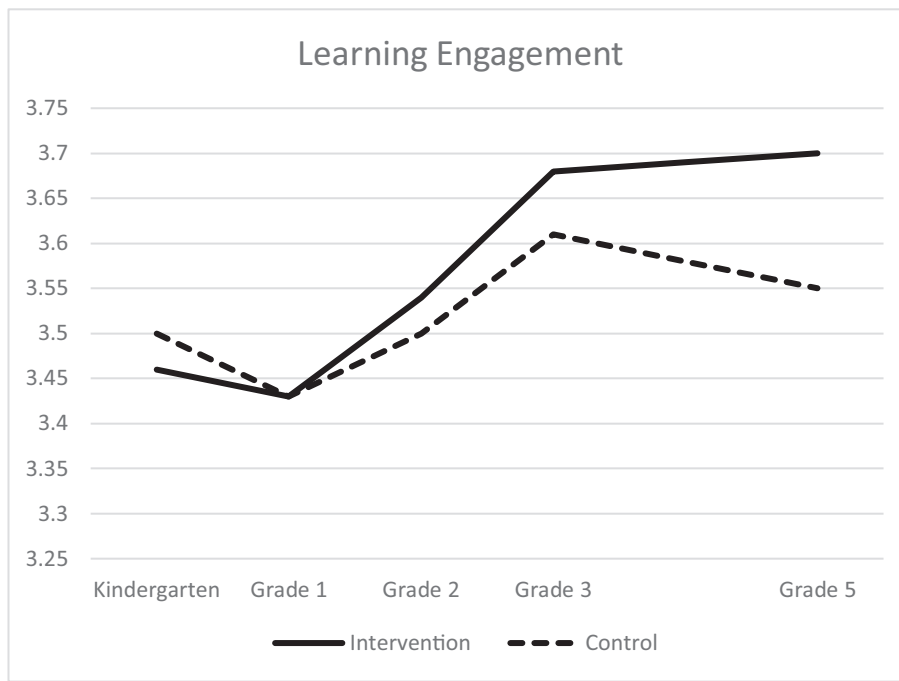
Parent-reported measures of academic expectations and parenting stress showed a different longitudinal pattern, with the adjustment of children in the control group declining over time at a faster pace than the adjustment of children in the intervention group. This pattern of effects suggests that intervention fostered changes in parenting attitudes and skills that promoted resilience and reduced declines in parent feelings of discouragement or dis-

stress about their child’s adjustment and educational future. Effects on parent academic expectations were correlated with teacher ratings of child academic performance, suggesting these effects were bolstered by the cross-domain sustained intervention effects in areas of reading skills, academic motivation, and learning engagement.

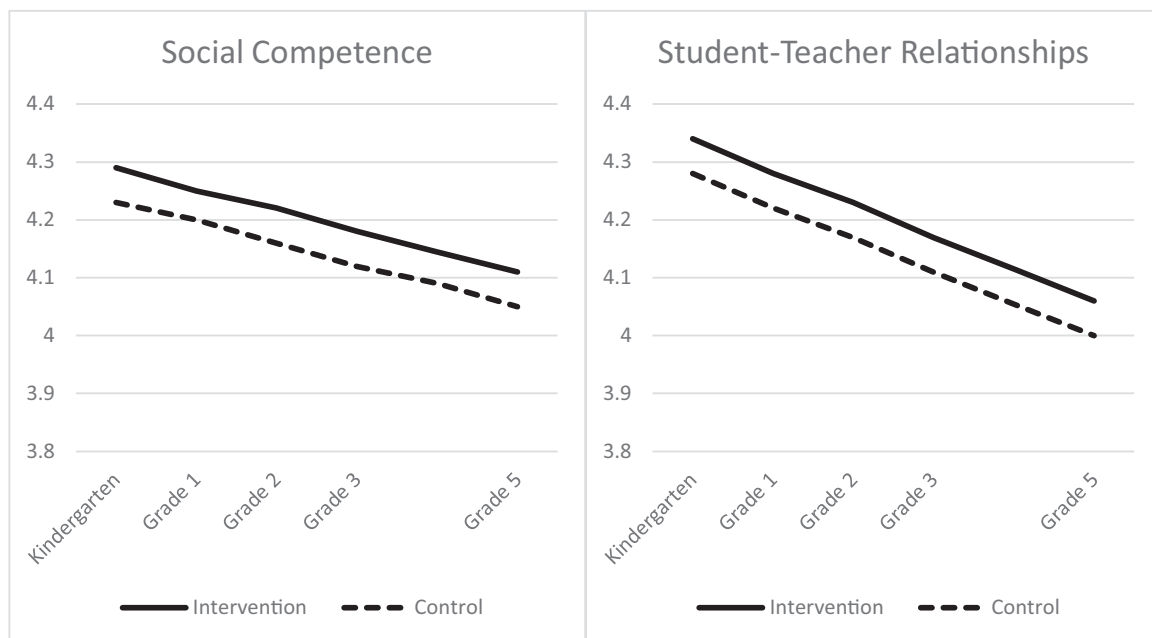
**7.2. Parenting risks and REDI-P intervention outcomes**

The second aim of this study was to explore the impact of preschool parenting risks on the sustained benefits of REDI-P. Prior studies suggest that low-income families are at elevated risk for experiencing challenges that impede their ability to provide optimal support for child development and learning. Risks such as low levels of education, single parent status, depression, and low parent-child warmth have been associated with reduced levels of child school adjustment and educational attainment (Amato, 2005; Baker & Iruka, 2013; Feder et al., 2009) and with reduced levels of engagement in parenting interventions (Baydar et al., 2003; Lundahl et al., 2006; Mol et al., 2008; Nix et al., 2018; Sheridan et al., 2011). These parenting risks may co-occur and operate cumulatively, with more risks amplifying the challenges faced by parents and the negative impact on child outcomes (Evans et al., 2013).





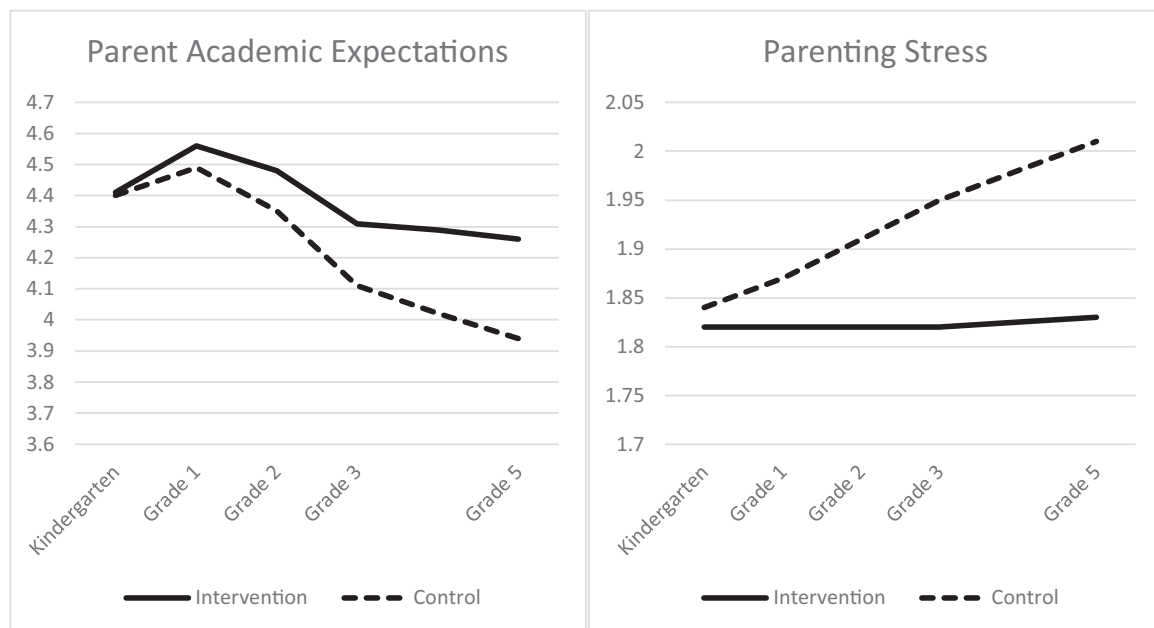
**Fig. 3.** Intervention effects on observer-rated learning engagement. Note: Predicted values are average item ratings derived from the growth curve models across kindergarten and first, second, third, and fifth grades, adjusted for covariates.



**Fig. 4.** Intervention effects on social competence and student-teacher relationships for children with fewer initial parenting risks. Note: Predicted values are average item ratings derived from the growth curve models across kindergarten and first, second, third, and fifth grades, adjusted for covariates.

The cumulative parenting risk score used in this study predicted fifth-grade outcomes for children, with more risks associated with lower levels of fifth-grade academic motivation, social competence, and student-teacher relationships, along with elevated levels of parenting stress and child problems. In addition, in all cases in which the effects of the REDI-P intervention varied by levels of parenting risk, benefits were larger at lower levels of initial parenting risk and attenuated among children from families experiencing higher levels of initial parenting risk.

Parenting risks may have reduced the sustained effects of REDI-P in at least two ways. First, prior research suggests that parent depression and low parent-child warmth reduced parent engagement in the REDI-P intervention, reducing use of the home learning materials and openness to the recommended parenting strategies (Nix et al., 2018). Modifications may be needed in the REDI-P intervention approach to more effectively support parents struggling with depression or conflictual parent-child relationships. For example, parents experiencing depression may need treatment fo-



**Fig. 5.** Intervention effects on parent academic expectations and parenting stress. Note: Predicted values are average item ratings derived from the growth curve models across kindergarten and first, second, third, and fifth grades, adjusted for covariates.

cused on their mental health concurrently with or prior to a child-focused intervention such as REDI-P. Parents who do not have a warm relationship with their child may benefit from an intervention focused on relationship-building. In particular, if parents experience conflict when trying to read with or play with their child and if children respond with impulsive and aggressive behavior, an alternative parenting approach focused on positive management strategies may be indicated (e.g., Brotman et al., 2013; Webster-Stratton et al., 2001) prior to, or as a supplement to, a home learning program like REDI-P.

Parenting risks may also reduce sustained effects by reducing parents' abilities to use the parenting strategies introduced during intervention to address child learning support needs or parent-child stressors in the subsequent years of elementary school, after the intervention has ended. Some families may need subsequent follow-up or booster interventions that help them sustain and adjust their parenting support as children move through middle childhood. Future research is needed to test the efficacy of different forms of supplementary intervention.

Although REDI-P did not produce sustained benefits on some measures for children from the highest risk families in this sample, it is important to keep in mind that families who had lower parenting risk scores in this sample still had children at substantial risk for school difficulties. That is, almost all families were living in poverty, 54% of the parents were unemployed, and only 4% of the parents had attained a 4-year college degree.

We know that when children participated in the REDI classroom program, compared to Head Start as usual, they demonstrated small to moderate gains in social adjustment, positive learning behaviors, and parent involvement that were sustained through the end of fifth grade (Welsh, Bierman, Nix, & Heinrichs, in press). The documented gains reported in this study for REDI-P were additional to those REDI-C effects. The lack of sustained main effects of REDI-P on child outcomes in the social-emotional domain (social competence and student-teacher relationship quality) may reflect the relatively strong impact of the REDI classroom program on these child outcomes at fifth grade (see Welsh et al., in press). Given that children in the REDI-P control group received the REDI classroom program, it may be that only the more responsive par-

ents with fewer parenting risks were able to implement REDI-P at a sufficient level to add to the sustained social-emotional benefits associated with the classroom program.

### 7.3. Study limitations

It is worth noting that only 52% of the eligible Head Start parents responded to the invitation to participate in REDI-P. To be included, parents had to indicate an interest in using home learning materials with their children and a willingness to participate in a lottery that would determine whether they would receive learning materials via home visits or through the mail. Hence, the parents who enrolled in the study may not be fully representative of the larger group of low-income parents with children attending Head Start. In addition, not all of the families who volunteered could be included in the study due to resource limitations. Families were enrolled as they completed baseline assessments, and more motivated or organized families may have responded faster to scheduling requests than other families. Randomization did not occur until after enrollment, so that any biases associated with the recruitment process were consistent across intervention and control groups, but they may have reduced the generalization of the present findings to the population base of low-income families.

In addition, because all children in this study (intervention and control) received the REDI classroom intervention program, it remains unknown whether REDI-P would have worked as well if children had received it as a "stand alone" program rather than as a companion to the REDI classroom program. The classroom program may have primed children to be more responsive to their parents because they were already familiar with the skills and activities. Additional research is needed to determine the effects of REDI-P alone.

With the exception of observer ratings of learning engagement, measures of school functioning were limited to teacher ratings, and measures of parent-child functioning were limited to parent ratings. Confidence in the findings would be bolstered by the availability of additional assessment methods and informants. Significant intervention effect sizes ranged from  $d = 0.21$  to  $d = 0.44$ . A

larger sample size would have provided sensitivity to more reliably detect smaller intervention effects.

#### 7.4. Implications for practice and policy

Family engagement has long been a basic tenet of the Head Start approach and 40 of the 50 states now have regulations that require schools to implement family engagement policies (U.S. Department of Education, 2013). Yet, family engagement programs continue to represent a key challenge to schools and represent the weakest area of compliance for schools receiving Title I funding (Markow, Macia, & Lee, 2012). The sustained benefits associated with REDI-P underscore the value and importance of intensive family engagement programming for low-income families around the transition from preschool into kindergarten. Intervening at this critical transition point may be particularly beneficial, as it is a period in which children's skill acquisition and learning behaviors are most malleable, creating the potential for increased parental support to benefit later developmental trajectories (Knudsen, Heckman, Cameron, & Shonkoff, 2006). Without intervention, parent involvement typically declines when children enter formal schooling (Rimm-Kaufmann & Pianta, 1999), with parents reducing their efforts to support child learning at home as children transition into elementary school, essentially passing the baton of educational support over to the school system (Powell et al., 2012). Results of REDI-P and other parent engagement programs suggest that boosting parent support for learning at this critical transition point may be highly strategic for reducing the achievement gap associated with family socio-economic disadvantage.

Prior research has demonstrated that effective parent support for home learning during the preschool years is multi-faceted, including frequent warm-sensitive parent-child interactions, extended parent-child conversations, shared reading, and collaborative parent-child involvement in learning games and activities (Fantuzzo, McWayne, Perry, & Childs, 2004). In longitudinal studies, Head Start parents who engage in these behaviors have children who display higher levels of learning motivation, attention, task persistence, receptive vocabulary, and aggression control (Fantuzzo et al., 2004). This study adds to this developmental literature by demonstrating the malleability of parent support for home learning and its positive impact on child outcomes in the context of a rigorous, randomized-controlled trial, supporting causal interpretations. As they completed elementary school, children who received REDI-P were more prepared than their control group counterparts for the upcoming challenges of middle school, and their parents were more confident about their children's ability to succeed. The sustained benefits evident in this longitudinal study offer hope that this approach may have even longer-term benefits beyond elementary school for REDI-P participants, promoting upward socio-economic mobility and thereby increasing future health and well-being. Fig. 1.

#### Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.ecresq.2021.03.017.

#### CRedit authorship contribution statement

**Karen L. Bierman:** Conceptualization, Investigation, Writing – original draft, Project administration, Funding acquisition. **Brenda S. Heinrichs:** Conceptualization, Investigation, Writing – review & editing, Funding acquisition. **Janet A. Welsh:** Conceptualization, Methodology, Formal analysis, Writing – review & editing. **Robert L. Nix:** Conceptualization, Investigation, Methodology, Writing – review & editing, Funding acquisition.

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