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Short-Term Intervention Effects of the PATHS Curriculum in Young Low-Income Children: Capitalizing on Plasticity

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Abstract

Deficits in behavioral and cognitive regulation are prevalent in children reared in poverty relative to more affluent children due to the effects of adverse conditions on the developmental underpinnings of these skills. Despite evidence to suggest that these emergent processes are susceptible to environmental inputs, research documenting short-term intervention program influences on these regulatory domains in young impoverished children is limited. We sought to determine the proximal effects of a universal school-based intervention (the PATHS Curriculum) on social, emotional, relational, and cognitive outcomes in urban poor kindergarten children. Four schools in high-poverty neighborhoods with similar demographic characteristics were randomly assigned to either PATHS or an attentional control. Teacher-reported measures of behavior (e.g., attention, concentration, aggression), peer nominations (e.g., likability, aggression, acceptance), and tasks gauging inhibitory control were administered in the fall of kindergarten and again in the spring after one academic year (about 6 months) of PATHS. Children who received PATHS exhibited significantly greater improvements than control students across all teacher-rated behavioral measures of social competence (i.e., emotion regulation, prosocial behavior, peer relations) and behavioral problems (i.e., aggression, internalizing behaviors, impulsivity and hyperactivity) at post-test as well as improvements in motor inhibition. This line of research constitutes an important frontier for prevention research given the implications for improving ultimate outcomes for otherwise disadvantaged children.

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Ethical Standards All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Keywords

Preventive intervention; Short term effects; Social competence; Behavioral problems; Early childhood

Introduction

Increasing the prevalence of children in high-poverty neighborhoods who are cognitively, emotionally, and socially ready to succeed in school and life is critical to ending intergenerational poverty and associated psychological, behavioral, and health problems (Yoshikawa, Aber, & Beardslee, 2012). Children in high-poverty neighborhoods are at great risk of deficits and delays in emergent self-regulatory systems due to the effects of adverse conditions, such as maltreatment, malnutrition, and environmental deprivation, on the developmental underpinnings of these skills (Raver, 2004). In general, children who do not develop effective self-regulatory skills are more likely to demonstrate academic and social failure (Diamond & Lee, 2011; Ramey & Ramey, 2004a, 2004b) and to eventually engage in high-risk behaviors, such as substance misuse (Stanis & Andersen, 2014). Despite evidence to suggest that essential developmental processes are susceptible to environmental inputs (Calkins, Propper, & Mills-Koonce, 2013; McCrory, De Brito, & Viding, 2010), research documenting the effects of short-term intervention programs on these domains in young impoverished children is limited. Our study focused on determining the proximal effects of a universal school-based intervention (the PATHS curriculum) on social, emotional, relational, and cognitive outcomes of urban poor kindergarten children. This line of research constitutes an important frontier for prevention research given its implications for improving ultimate outcomes for disadvantaged children.

Developmental Plasticity and Preventive Interventions

Throughout childhood, the brain is substantially plastic, and the development of cognitive, emotional, and behavioral brain-based systems is highly sensitive to environmental influences. Psychosocial and physical experiences during childhood play a significant role in sculpting brain function, with life-long implications for social and behavioral outcomes. Proximal conditions such as educational supports, family functioning, physical activity, and nutrition are essential ingredients, translating to either a suboptimal developmental trajectory or, conversely, to resiliency that protects against the impact of adverse environmental and genetic vulnerabilities. The provision of high-quality educational programs that strengthen these conditions is expected to lead to healthier overall child development and reduced risk of later psychopathology.

The developmental sciences inform us that throughout childhood there are several critical windows to alter brain and behavioral functioning, for better or for worse. Throughout this lengthy period, the development of an integrated system of affect, language, behavior, and cognitive skills is of primary importance for later awareness, self-regulation of behavior, and coping (Greenberg & Kusche, 1996). As youth mature, emotional development precedes higher-order cognitive development, and a primary developmental goal is to equip children with the linguistic and cognitive skills to help them learn to regulate emotion in the

service of prosocial interactions (Eisenberg & Fabes, 1992). By doing so, children learn self-control and behavioral regulation as well as the ability to plan ahead in complex behavioral sequences. This integration is believed to occur as a result of maturation of fronto-limbic circuits, which recruit executive cognitive functions (ECF) to exert effortful control (voluntary control over approach or inhibitory behavioral tendencies) over behavior in emotional contexts. Exposure to adversity (such as poverty) in the proximal environment is associated with deficits and delays in these experience-dependent brain maturational processes (McCrory et al., 2010). Programming is thus needed to support children in learning these essential skills from early childhood in order to enable socially competent actions, such as prosocial behavior and effective coping skills, to reduce risk for school failure and psychopathology.

The PATHS Curriculum

We examined the effectiveness of one classroom-based intervention model, the PATHS curriculum, which is a universal social-emotional program designed to improve skills in four domains (self-control/emotion regulation, attention, communication, and problem solving). In turn, through improvements in these competencies, PATHS is expected to reduce problem behavior. The PATHS curriculum is currently used in more than 3000 elementary classrooms in the United States and approximately 500 schools in other countries (e.g., throughout Europe, the Middle East, Asia and Australia). PATHS has been shown to be effective in improving the social and emotion-knowledge skills of children in preschool (Domitrovich, Cortes, & Greenberg, 2007) and in Grades 1 through 4 (Greenberg, 2004; Riggs, Greenberg, Kusche, & Pentz, 2006; Seifer et al., 2004). However, this study represents the first randomized trial to examine the effectiveness of PATHS at the kindergarten level (e.g., entrance to formal schooling in the U.S.) into first and second grade.

The PATHS curriculum is based on the Affective-Behavioral-Cognitive-Dynamic model of development (Greenberg & Kusche, 1996; Kusché & Greenberg, 2012), which places primary importance on the developmental integration of affect, expressive language, behavior, and cognitive understanding. A child's coping, as reflected in behavior and internal regulation, is a function of emotional awareness, affective-cognitive control, and social-cognitive understanding. As emotion regulation (from infancy) precedes language, young children experience emotions and react to them long before they can verbalize their experiences. Children's ability to control their behavior in the service of goals becomes slowly developmentally coupled with their cognitive and linguistic abilities through the integrated process of linking language, executive functions (inhibitory control, planning), and interpersonal interactions. This integrated process of social and emotional learning supports both prosocial and positive behavior and recruits newly developed executive and linguistic functions to exert effortful control over behavior in emotional contexts (i.e., frustration, anger). These processes of brain maturation are important in achieving socially competent action and healthy peer relations.

Given this conceptual framework, the PATHS curriculum places special emphasis on neurocognitive models of development (Greenberg & Kusché, 2006). Of particular importance are the concepts of vertical control and verbal processing of action. Vertical

control is the process of higher-order cognitive processes exerting control over lower-level limbic impulses vis-à-vis the development of frontal cognitive control (Luria, 1966). PATHS attempts to consciously teach children the processes of vertical control by providing opportunities to practice conscious strategies for self-control and problem-solving.

Randomized trials conducted in both urban and rural locations (CPPRG, 1999, 2007; Kam, Greenberg, & Walls, 2003; Riggs et al., 2006) with multi-ethnic children in Grades 1–4 have reported that PATHS reduces externalizing problems (e.g., aggression, emotional dysregulation) and internalizing symptoms (e.g., depression, anxiety), and increases participants' ability to regulate emotions, plan for the future, and tolerate frustration. Several randomized trials of the PATHS curriculum in Head Start classrooms have shown effects on social competence, but no effects on externalizing behavior after one year of implementation (Domitrovich et al., 2007; Morris et al., 2014). Although these efforts have determined that PATHS significantly improves these outcomes, effect sizes have been mixed and relatively modest (.2 to .4) and no study has evaluated the curriculum's effect on children in kindergarten settings when they are first transitioning to elementary school.

The Current Study

Our study examined the proximal influence of PATHS on high-poverty urban children when implemented during kindergarten, and whether its use can redirect behavioral, relational, and cognitive abilities at school entrance. Children who received PATHS were expected to perform better than control children on teacher-reported measures of behavior (e.g., attention, concentration, aggression) and peer nominations (e.g., likability, aggression, acceptance) after one school year of exposure to the curriculum. We also explored the potential for short-term effects of the intervention on level of neurocognitive functioning.

Methods

Design Overview

This study employed a design in which four public elementary schools in Baltimore City were selected from highly disadvantaged neighborhoods where school readiness is relatively low. We identified a number of schools based on kindergarten class size, percentage of students receiving free or reduced lunch (a socioeconomic measure of poverty), mean level of 3rd-grade academic proficiency, and rates of neighborhood juvenile arrests. Four schools were selected after obtaining principal and teacher agreement. Schools were then randomly assigned to an experimental or control condition (PATHS is administered grade-wise within a school, and thus randomization could not occur by classroom). The similarity between the communities that the schools serve in terms of socio-demographic mix, crime rates, income level, free or reduced lunch participation, disciplinary rates, and standard achievement scores provides some confidence that the student bodies are comparable and there would be little variability in demographic characteristics in these neighborhoods (see Table 1).

Participants

Children in the kindergarten classrooms of all four schools were recruited during two staggered waves (in two cohorts) to achieve an adequate sample size per condition. All

kindergarten children were recruited to participate in the study; parental refusal to consent did not exclude children's class participation, but they were not included in the research. Meetings were held to explain the program to parents, teachers, and school administrators. Recruitment flyers were sent home by teachers, announcements and presentations were given at meetings attended by parents. Follow-up calls or home visits were made to parents who requested more information or are otherwise unreachable. Classrooms that returned at least 80 % of consent forms, regardless of parents' decision concerning their children's participation, were given a pizza party as a bonus for their efforts.

Nearly all caregivers who were approached or received flyers agreed to participate. There were approximately 464 children in the four schools and 327 of those provided caregiver consent based on a combination of the return of signed consent forms and our ability to make direct contact.

Intervention

The Preschool/Kindergarten version of the PATHS curriculum was used as the primary intervention (Domitrovich, Greenberg, Cortes, & Kusche, 2004). This program is organized around a core set of 44 lessons that are used by teachers to introduce key curriculum concepts. Lessons were taught twice per week for approximately 20 min and utilized direct instruction, puppet presentations, and stories to help children learn cognitive/behavioral strategies for calming down (e.g., the Turtle Technique), labeling emotions (e.g., Feeling Faces), and problem-solving (e.g., The Control Signal). Discussion and role-playing activities were used to provide children with a chance to practice skills and for teachers to monitor students' level of understanding and skill. Although a standard script describes each lesson, teachers are encouraged to adjust the level of presentation and amount of practice as dictated by the responsivity and developmental level of each class. Approximately 40 % of the lessons focus on skills related to understanding and communicating emotions, 30 % focus on skills designed to increase positive social behavior (e.g., social participation, prosocial behavior, communication skills), and 30 % on teaching management and problem solving.

While lessons are a central component of the PATHS program, regular practice and ongoing application of the curriculum concepts to real-world situations is considered essential to children's skill acquisition. Teachers are provided with ideas for daily routines, extension activities, and generalization techniques to support children's use of skills in the classroom and in other settings outside the classroom. The generalization techniques (e.g., dialoguing in conflict situations or prompting students to calm down) are particularly important for supporting students in applying PATHS skills in the emotionally charged or "hot" situations (e.g., conflict with others or frustration) that naturally that occur throughout the school day. To generalize learning in the home, the curriculum includes frequent parent updates on curriculum content and suggestions for parents on how to promote children's growing competence.

Training and Implementation Support Model

The intervention teachers attended a two-day training workshop that was held in the summer before they began the first implementation year. Lessons began in October and continued until May of each school year. During the school year the teachers received weekly consultation from an experienced PATHS Coordinator (PC) that included classroom observations four times a year and ongoing meetings as needed. Teachers were paid a minimal amount for their extra preparation and consultation time. The weekly consultations enhanced the quality of implementation through modeling, coaching, and providing ongoing feedback regarding program delivery. The PC also provided general feedback on classroom and behavior management on a regular basis. The PC spent an average of 2–3 h per week in each classroom either observing, demonstrating, or team-teaching PATHS lessons, and meeting individually or in groups with teachers. Teachers tracked their program delivery over the course the year and the PC checked in with teachers about their lesson delivery every week. This resulted in a high level of fidelity, with all teachers completing at least 80 % of the lessons both years. Fidelity of the PATHS program delivery was also assessed through ratings of teachers made by the PC based on direct observation of curriculum delivery. The ratings reflected the degree to which teachers conducted PATHS lessons with fidelity to the content, modeled the program techniques, extended the curriculum concepts throughout the day, and supported children's use of program strategies in real situations. All ratings were made on a 5-point scale. The average score across the four intervention classrooms on each rating was above 3.80.

Measures

Demographics—We conducted an initial telephone, in-person or mail interview with the primary caregiver to obtain background information about the child's home and family life, as well as medical and behavioral history. As some caregivers consented to their child's participation but were not available for this interview (many do not accompany their children into the school), there was a substantial amount of missing background data. The test battery included measures of IQ, inhibitory control, emotion regulation, teacher-rated behavior, and peer-nominations.

Procedures for Teacher Ratings and Child Testing—We administered all instruments in the beginning of the fall kindergarten semester (Wave 1) and again in the spring for both students and teachers, after about 6 months of PATHS exposure for the intervention schools (Wave 2). Peer sociometric nominations, however, were conducted post-kindergarten given the need to provide the students with time to familiarize themselves with their classmates. Children were individually assessed in a school room in two test sessions of less than 45 min.

Teacher-Rated Behavioral Measures—Kindergarten teachers completed a series of measures assessing child competencies. The 13 items of the Social Competence Scale (Conduct Problems Prevention Research Group [CPPRG], 1995) were rated on a 6-point Likert scale (*never* to *almost always*). The Prosocial Behavior subscale was assessed with seven items such as "Shares with others" and "Is helpful to others" ($\alpha = .96$). The Emotion Regulation subscale was assessed with six items such as "Copes well with disappointment

or frustration" and "Controls temper when there is a disagreement" (α = .88). Seven items from the Teacher Observation of Child Adaptation-Revised (TOCA-R; Werthamer-Larsson, Kellam, & Wheeler, 1991) assessed overt aggression (e.g., stubborn, yells, fights). We made some wording modifications to assure that the items were developmentally appropriate for preschool children. Items representing internalizing behaviors included two that described social withdrawal, taken from the *TOCA-R*, and three that we drew from other behavior problem scales developed for young children. Each item was rated on a 4-point scale (where 1 = *almost never* and 4 = *almost always*). To assess Diagnostic and Statistical Manual symptoms of attention-deficit/hyperactivity disorder, teachers completed the ADHD Rating Scale (DuPaul, 1991) which comprises 14 items. Six items reflect attention problems (α = .92; "Is easily distracted") and eight items reflect hyperactivity (α = .94; "Has trouble sitting still"). Each item is rated on a 4-point scale (where 1 = *not at all* and 4 = *very much*).

Teachers also completed the Student–Teacher Relationship Scale (Pianta, 2001), which used eight items to assess student–teacher closeness (α = .90; e.g., "I share an affectionate, warm relationship with this child") and eight items to assess student–teacher conflict (α = .92; e.g., "This child becomes easily angry with me"). Each item was rated on a 5-point Likert scale (where 1 = *definitely does not apply* and 5 = *definitely applies*).

To assess the quality of peer relations, teachers completed the Peer Relations Questionnaire (PRQ) which assesses the degree to which a student was liked and disliked by classmates, left out or ignored, and teased or picked on (Ladd & Profilet, 1996). Each item is rated on a 5-point scale (1 = *almost never* and 5 = *almost always*). A total score was created by averaging the four items (α = .79).

Teachers also provided ratings of students' academic skills by completing four items drawn from the Academic Competence Evaluation Scales (DiPerna & Elliott, 1999). The first two items assessed children's literacy and math skills on a 4-point scale (1 = "*near the very bottom of your class*" and 4 = "*near the top of your class*"). The third item assessed children's overall academic functioning and was rated on the same 5-point scale as the first two items. The final item asked teachers to rate the likelihood that the child would progress to the next grade level. This rating was made on a 4-point scale (where 1 = *highly unlikely* and 4 = *definitely yes*).

Peer Nominations—We used peer reports of positive and negative nominations, desire to play with a classmate (play difference), and likability (liking difference) after kindergarten via individual sociometric interviews for each child. For play and liking ratings, the interviewer placed three pictures of faces in front of the child; a "like a lot" face, a "don't like [to play with]" face, and a neutral face in the middle. The interviewer read aloud the name of each child on the class roster and asked if the child knew that child. If the child said "no," the interviewer went to the next name on the roster. If the child said "yes," the child was asked to point to which face they would choose for that child. Ratings for play and liking nominations were operationalized as an outcome by creating a difference score that subtracted the number of "don't like [to play]" responses from the "like [to play]" number. A mean positive score was created as the average of reports of liking a peer a lot, peer's friendliness, cooperation, and "coolness." A negative mean rating was calculated

using ratings of liking a peer less, fights with peer, and meanness of peer. For unlimited positive nominations, the child was asked “In your classroom, who do you like a lot?” For unlimited negative nominations, the child was asked, “In your classroom, who don’t you like as well as others?” For both sets of nominations, if the child gave fewer than three, they were prompted a second time. We used the classroom’s mean scores for all children which were then standardized across the entire sample within each cohort.

Cognitive Functioning

Intelligence—Intelligence has been shown to change with intervention, particularly in disadvantaged children (Chapin & Altenhofen, 2010; Dawson et al., 2010; Ramey & Ramey, 2004a, 2004b). Thus, we used the KBIT-2, an estimated intelligence measure that produces two verbal and one nonverbal subscales as well as an intelligence composite score (Kaufman & Kaufman, 1990). The KBIT-2 is often recommended for identifying children who are at risk for academic issues (Bain & Jaspers, 2009). It was developed in conjunction with the Kaufman Assessment Battery for Children—second edition (KBAC-II), and parallels many of its constructs such as the interpretative framework based on the Cattell-Horn-Carroll (CHC) theory of intelligence. The KBIT-2’s internal reliability coefficients for the IQ composite ranges from .89 to .96 across age groups with slightly lower coefficients for the nonverbal (.91) and verbal (.88) subscales; however, nonverbal scale coefficients were as low as .78 for individuals between ages four and five (Kaufman & Kaufman, 1990).

Motor Impulsivity—The Peg-Tapping Task assesses working memory and inhibitory control (Diamond & Taylor, 1996). During this task, we instructed participants to tap their peg twice with a wooden dowel when the experimenter taps once and once when the experimenter taps twice. Successful performance of this task requires the participants to hold the tapping rule in working memory while inhibiting opposing responses (Pellicano, 2007). After practice trials, participants are administered a series of 16 trials in a pseudorandom sequence (8 one-tap and 8 two-tap trials).

Delay of Gratification—Delay of Gratification (DoG) tasks are used to gauge the ability to delay receipt of an initial smaller reward to attain a larger or better but later reward. Preschoolers who were able to delay gratification longer exhibit higher cognitive, self-regulatory, and prosocial abilities as adolescents (Sethi, Mischel, Aber, Shoda, & Rodriguez, 2000). Further, individuals less able to delay gratification as children are more likely to sustain low self-regulatory behaviors in their early-and mid-adulthood years. We told participants that they could have a preselected prize contained in a box (i.e., the DoG box) or that they could select any prize from a larger selection box if they could remain seated and refrain from touching the DoG box for 10 min while the experimenter completed paperwork. Key variables generated from this task include “delay” (time waited for reward), “activity level” (rating of degree to which child fidgeted), “number of corrections” (corrections for inappropriate behavior), and “overall difficulty” (rating of difficulty on the part of the child during the waiting period).

Behavioral Inhibition—The Whack-A-Mole (WAM) is a Go/No-Go task designed to investigate inhibitory control in children. This computerized task presents images in rapid

succession of a mole (which occurs more often) or an eggplant popping up in a garden. We instructed participants to press the spacebar on the computer's keyboard whenever the mole appeared but to withhold their response when the eggplant appeared. Shorter reaction times in Go trials and higher percentages of correct responses (i.e., fewer commission errors) in No-Go trials are associated with greater inhibition and emotion regulation (Hirose et al., 2012).

Facial Emotion Recognition—The "FACES task" (Ekman & Friesen, 1975) was administered at the second wave of data collection to measure the ability to accurately identify emotional expressions in other people's faces. We instructed participants to identify the emotion (happiness, anger, disgust, surprise, sadness, and fear) and neutral faces that best described the facial expression. A practice trial was given to familiarize children with the task, after which 70 pictures of varying emotional intensity were presented. The scores produced are the number of correct attributions of each emotional expression and total correct responses.

Analytic Strategy

A multilevel model equivalent to a two time-point longitudinal growth model was used to estimate the impact of PATHS on students for the majority of dependent variables. Up to two observations were nested within each student, and the principal estimate of the intervention effect was the group (PATHS vs. control) by time (baseline to follow-up 1) interaction. This parameter estimated differences in change over time by treatment condition; standardized betas were utilized as a measure of effect size. School was not included as a random effect in the multilevel model due to insufficient number of units ($N = 4$ schools) at that level. Models were estimated in SAS PROC MIXED, and included an intercept random effect. Child gender was included as a control measure in all models. As noted above, two measures (Facial Recognition Task, Peer Nominations) were only assessed at the follow-up. These items were examined with a simple group difference model controlling for child gender.

Preliminary analyses revealed significant baseline differences across treatment condition for multiple behavioral outcomes. As these differences could potentially lead to spurious conclusions about the efficacy of PATHS, a secondary analysis dataset was formed by matching students in treatment and control conditions based on propensity scores generated from a regression model predicting treatment from child gender and both cognitive and behavioral outcome measures collected at baseline. A total of 114 out of the total 327 cases (35 %) cases were matched and all analyses were repeated on this subsample as a sensitivity analysis of the effect of baseline group differences. Only four outcomes were significantly different at baseline in the matched sample compared to 10 outcomes in the full sample. Results for change over time using propensity scores are also reported below.

Results

Behavioral outcomes—teacher reported and peer nominations—exhibited almost universal intervention effects (see Table 2). Measures of Aggression and Internalizing both decreased significantly more in PATHS students than in comparisons. The total Social Competence scale showed a significant intervention effect with greater improvements in the intervention

students. There were also significant effects for intervention students on both the Emotional Regulation subscale and the Prosocial Behavior subscale.

All CAS outcomes showed greater improvement in PATHS students. The CAS Total score decreased at a greater rate as did the specific subscales for Impulsivity and Inattention. STRS outcomes also showed improvement on the Total Score, as well as for both the Closeness and Conflict subscales.

The remaining two outcomes that we assessed at both baseline and follow-up, Peer Relations Questionnaire and Academic Skills total, each showed greater improvement over time in the PATHS condition. PRQ showed greater decreases for PATHS students, whereas Academic Skill total improved more for the PATHS group. The majority of the post-test-only peer nominations outcomes also showed group differences. The mean for negative nominations was significantly lower in the PATHS group (11 vs. 15 %). However, the positive nominations were also lower in the intervention group (18 vs. 22 %). The difference between liking and not liking a peer did not differ significantly but the play difference score was significantly higher in PATHS students, indicating a greater percentage reported liking to play with the peer in question (25 vs. 16 %).

Results from the propensity score-matched sample were quite similar to those for the full sample. The only differences were for change over time for Skills total score and STRS Closeness, which were no longer significant. The post-test difference for peer nominations for playing with peers and positive nominations were not significant in the matched sample.

In addition to child behavioral outcomes, we examined direct, short-term effects of PATHS on student performance of inhibitory control and emotion regulation tasks. Table 3 displays model estimates for these effects of PATHS as well as model adjustments means by treatment condition and assessment time. Overall, there were few intervention differences in these cognitive tests. No intervention effects were found for DoG measures or for FACES (which was only administered in both cohorts at Wave 2). Activity level for DoG showed a significant increase over time in both groups. Go/No-Go variables showed improvements in both groups, with an increase in both Go and No-Go accuracy and decrease in Go average response time.

A significant intervention effect was found for Peg Tapping total correct score. The total number of correct responses increased to a greater degree in PATHS than comparison students. The matched group difference (using propensity scores) in change over time for Peg Tapping correct responses was not significant; however, this analysis was performed on a much smaller subsample.

Discussion

Our study found that children who received the PATHS curriculum exhibited greater improvements than control students across all teacher-rated behavioral measures of social competence (i.e., emotion regulation, prosocial behavior, peer relations) and behavioral problems (i.e., aggression, internalizing behaviors, impulsivity and hyperactivity) at post-test. The intervention’s effect on these outcomes is impressive when considered relative to

the fact that the intervention students were described by teachers as having higher levels of problems and lower levels of competence at baseline than control students. The magnitude of the effect on students' behavior across such a short time span was unexpected and greater than previously documented for the curriculum.

This investigation of the PATHS curriculum is important for several reasons. It is the first independent evaluation of the short-term effects of the program when implemented with low-income, largely minority students in kindergarten. Previous PATHS evaluations have included preschool age children and students in early elementary grades (Domitrovich et al., 2007; Morris et al., 2014) but this study is the first to document program effects with students in kindergarten. Until recently, the majority of the research on PATHS has been conducted by the program's developers. This is changing and the current study represents one of several independent U.S. trials conducted by outside research teams that found positive effects when studying the program (Crean & Johnson, 2013; Hamre, Pianta, Mashburn, & Downer, 2012; Schonfeld et al., 2015). Our findings are consistent with previous research documenting the positive impact that can be achieved with one year of PATHS implementation, but builds on this research by documenting the effect on a more diverse set of outcome measures than have been previously assessed in a single study. As a result, the findings also strengthen the evidence-base for school-based SEL programs more generally.

PATHS is designed to promote emotion knowledge and self-regulation of behavior and affect in students by teaching them to recognize the internal and external cues of affect and to label them with appropriate terms (Greenberg & Kusché, 2006). Due to this explicit emphasis of the program, children's facial recognition skills were assessed in the current study. There were no differences between the intervention conditions on this measure. We did not have baseline measures on this task for both cohorts; thus, this post-test only analysis does not permit a determination of possible baseline differences.

PATHS lessons are designed to improve children's peer relations by teaching them good manners, how to take turns and share when playing with others, and how to listen to others, which are all critical skills for positive social interactions. Positive social behaviors are also elicited and reinforced during and outside of lessons. In addition to program effects on teacher ratings of students, there was also evidence that PATHS students were perceived by their peers as more competent than their peers in control classrooms after participating in the program. Students in PATHS classrooms were rated as having fewer negative peer interactions and more positive nominations than control students. Although reports of liking target peers did not differ between groups, intervention children more often reported "liking to play" with target peers. Given the significant intervention effect on teacher-rated behavioral problems for PATHS participants, the improvements in peer relations between the groups are particularly interesting. Intervention teachers also reported that they felt closer to their students than did teachers in control classrooms. While this may be a function of using the curriculum in the classroom, the positive peer ratings suggest that the behavior of PATHS students may have changed in ways that also improved the quality of their relationships with teachers.

PATHS places special emphasis on supporting children's cognitive development (Greenberg & Kusché, 2006). Of particular importance are the concepts of vertical control and verbal processing of action (e.g., horizontal control). Vertical control is the process of higher-order cognitive processes exerting control over lower-level affective impulses. PATHS attempts to teach children the processes of vertical control by providing opportunities to practice conscious strategies for self-regulation and problem-solving. While there was some evidence for improvement in working memory and inhibition (as assessed with the Peg-Tapping task) in response to PATHS, overall the intervention effects on behavior and social competence were greater and more consistent than were outcomes related to cognitive measures.

For the most part, both intervention and control children showed similar increases in executive cognitive functions over time, as expected. The exception was the Peg-Tapping task on which PATHS recipients exhibited greater improvements in working memory and inhibition and this effects may be related to later improvements in behavior (e.g., Jaušovec & Jaušovec, 2012; Schmeichel & Demaree, 2010) and academic skills (Alloway & Alloway, 2010). This finding parallels those found in a study of PATHS (along with language intervention) on the Dimensional Card Sort in the Head Start REDI (Research-Based Developmentally Informed) study (Bierman, Nix, Greenberg, Blair, & Domitrovich, 2008). IQ tends to account for a smaller portion of unique variance to these outcomes, relative to working memory. The results from Alloway and Alloway (2010), for example, demonstrated that working memory is not a proxy for IQ but rather represents a dissociable cognitive skill with unique links to academic attainment; it may be a more powerful predictor of subsequent academic success than IQ. Other than motor impulsivity, the relative lack of cognitive effects in response to PATHS was surprising; we had initially hypothesized that PATHS has the potential to influence emergent cognitive functions and emotion perception (FACES). These questions will be further explored in subsequent mediation analyses on the full dataset (through 2nd grade).

Study Limitations

Despite positive findings, the current study had several limitations. First, it is likely that students within schools were more similar to one another than to students at other schools. This clustering could not be incorporated in the analysis models given the small number of schools. Second, the reliance on teacher report data may introduce some measurement error although this may be mitigated by multiple teachers giving responses in each school and condition. Given the significant intervention effect on teacher-rated behavioral problems for PATHS participants, the improvements in peer relations between the groups are particularly interesting.

Conclusions

The take-away message from this study of short-term intervention effects may be that behavioral pathways can be effectively redirected in a significant subset of children, with the possible distal effect of increasing resiliency against negative outcomes. Even very young children can manifest early predictors of future mental, emotional, and behavioral disorders which eventually increase risk for drug abuse and other forms of psychopathology. Children

who are more aggressive with their peers are more likely to experience difficulties in making friends and have serious behavior problems, including criminal activity and drug abuse, as adolescents and adults. Also, children who refuse or are unable to follow instructions from teachers and adults are more often poorly judged and treated punitively in the classroom and at home, which can exacerbate their underlying problems. Such risky behavior also often leads to unsafe situations at home and in the neighborhood. The short-term findings from this study show that these are malleable targets for intervention and support the contention that SEL programs that bolster the quality of early childhood education and focus on strengthening self-regulatory behaviors may exert a profound and potentially lasting influence on overall successful outcomes. Effects on early prosocial behaviors are an important and unique predictor of adult labor market outcomes, such as graduation, employment and delinquency (Jones, Greenberg, & Crowley, 2015). Future work to track program effects overtime will, indeed, be needed to determine their longevity. Studies to enhance our understanding of the role of underlying functions that modulate self-regulatory behaviors in intervention outcomes are critical to determining ways in which PATHS can be improved to benefit a greater number of children.

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Table 1

School and neighborhood characteristics

	Control 1	Control 2	PATHS 1	PATHS 2
School characteristics				
State Ranking				
Statewide Rank (out of 847 schools)	819	678	588	749
Free and Reduced Meal Service (FARMS) (SY-09)				
Free Lunch	355	548	329	475
Reduced Lunch	14	40	38	55
Paid Lunch	28	45	23	115
Suspension Rate (SY-09)	18	41	75	73
Enrollment				
Total Enrollment (SY-09)	423	612	395	657
Enrollment by Race				
Caucasian	0	7	1	58
African American	422	600	394	575
Asian/Pacific Islander	0	5	0	7
Hispanic	1	0	0	16
American Indian	0	0	0	1
Two or More Races	0	0	0	0
Characteristics of areas (by zip code) served by schools				
Race (%)				
Caucasian	9.4	14.3	9.7	25.9
African American	86.5	81.2	83.8	68.1
Asian/Pacific Islander	1.2	0.7	1.1	1.5
Hispanic	1.4	2.3	3.4	2.1
American Indian	0	0.2	0.2	0.3
Two or More Races	1.5	1.2	0	2.1
Household Income[a]	27,139	34,968	52,462	48,721
Crime (per 1000 residents)[a]				
Overall Crime	112.42	58.06	49.5	40.84
Violent Crime	24.78	23.44	7.07	9.46
Domestic Violence	62.54	51.12	55.35	42.46

[a]2010 data

Table 2

Program effects and model-adjusted means on teacher ratings of behavior and peer nominations

Dependent variable	Model estimates unstandardized beta (*SE*)				Model-adjusted means estimate (*SE*)			
					Comparison		PATHS	
	Intercept	Group	Time	Time by Group	Baseline	Follow-up	Baseline	Follow-up
Aggression	2.39(0.18)	0.05(0.11)	0.29(0.07)***	−0.46(0.09)***	1.79(0.08)	2.08(0.08)	1.84(0.08)	1.66(0.08)
Internalizing	1.86(0.13)	0.38(0.08)***	0.04(0.06)	−0.55(0.08)***	1.73(0.06)	1.77(0.06)	2.12(0.06)	1.61(0.06)
Total Social competence	4.39(0.17)	−1.07(0.11)***	0.11(0.08)	0.89(0.12)***	4.76(0.08)	4.86(0.08)	3.68(0.08)	4.68(0.09)
Emotion regulation	4.25(0.18)	−0.76(0.11)***	0.08(0.09)	0.72(0.12)***	4.66(0.09)	4.74(0.09)	3.89(0.09)	4.69(0.09)
Prosocial behavior	4.51(0.18)	−1.34(0.12)***	0.13(0.09)	1.03(0.13)***	4.84(0.09)	4.97(0.09)	3.5(0.09)	4.66(0.09)
Child Activity Scale								
Impulsivity	2.13(0.13)	−0.06(0.08)	0.03(0.05)	−0.21(0.07)**	1.66(0.06)	1.69(0.06)	1.6(0.06)	1.42(0.06)
Inattention	2.1(0.13)	−0.02(0.08)	−0.02(0.04)	−0.19(0.06)**	1.67(0.06)	1.65(0.06)	1.65(0.06)	1.44(0.06)
Total	2.11(0.13)	−0.04(0.08)	0.01(0.04)	−0.2(0.06)***	1.66(0.05)	1.67(0.05)	1.62(0.06)	1.43(0.06)
Student–Teacher Relationship Scale								
Closeness	4.32(0.11)	−0.45(0.07)***	0.09(0.05)+	0.44(0.07)***	4.51(0.05)	4.6(0.05)	4.06(0.05)	4.58(0.05)
Conflict	2(0.16)	0.13(0.1)	0.09(0.06)	−0.19(0.09)*	1.56(0.07)	1.65(0.07)	1.69(0.07)	1.59(0.07)
Total	4.16(0.12)	−0.29(0.08)***	0(0.05)	0.31(0.07)***	4.48(0.05)	4.48(0.05)	4.19(0.05)	4.5(0.05)
Peer Relationship Questionnaire Total	1.7(0.12)	0.5(0.08)***	0.09(0.05)+	−0.5(0.08)***	1.45(0.06)	1.54(0.06)	1.94(0.06)	1.54(0.06)
Skill Total	2.98(0.21)	−0.4(0.13)**	0.12(0.09)	0.32(0.13)*	3.58(0.09)	3.69(0.09)	3.17(0.09)	3.61(0.1)
Peer nominations								
Liking difference	−0.1(0.05)	−0.03(0.03)	na	na	na	0.10(0.02)	na	0.07(0.02)
Negative nominations	0.28(0.03)	−0.04(0.02)**	na	na	na	0.15(0.01)	na	0.11(0.01)
Play difference	−0.07(0.08)	0.09(0.04)*	na	na	na	0.16(0.03)	na	0.25(0.03)
Positive nominations	0.14(0.03)	−0.04(0.02)**	na	na	na	0.22(0.01)	na	0.18(0.01)

* $p < .05$

** $p < .01$

*** $p < .001$

$^{+}p < .10$

Table 3

Program effects and model-adjusted means for student direct tests of cognitive function

Dependent variable	Model estimates Unstandardized beta (*SE*)				Model-adjusted means Estimate (*SE*)			
					Comparison		Intervention	
	Intercept	Group	Time	Time by Group	Baseline	Follow-up	Baseline	Follow-up
Delay of Gratification								
Activity Level	0.88(0.12)	0.10(0.09)	0.38(0.08)***	0.01(0.12)	0.91(0.06)	1.29(0.06)	1.01(0.07)	1.4(0.07)
Delay, minutes	5.18(0.4)	0.08(0.3)	0.52(0.29)+	−0.32(0.43)	5.44(0.21)	5.96(0.21)	5.53(0.22)	5.73(0.23)
Overall difficulty	1.22(0.27)	0.12(0.2)	−0.25(0.19)	0.17(0.27)	1.01(0.13)	0.76(0.14)	1.12(0.14)	1.05(0.15)
No. of corrections	0.38(0.16)	0.04(0.12)	−0.16(0.11)	−0.10(0.16)	0.42(0.08)	0.26(0.08)	0.46(0.09)	0.20(0.09)
Inhibition								
Go accuracy	0.90(0.02)	0.03(0.01)*	0.04(0.01)***	−0.03(0.01)*	0.90(0.01)	0.94(0.01)	0.92(0.01)	0.94(0.01)
Go average response time	662.15(20.19)	−19.66 (13.64)	−50.85 (10.06)***	11.59(14.94)	732.36(9.23)	681.51(9.45)	712.7(10.04)	673.44(10.03)
No-Go accuracy	0.61(0.03)	−0.01(0.02)	0.07(0.02)***	0(0.02)	0.72(0.01)	0.79(0.01)	0.71(0.02)	0.79(0.02)
No-Go average response time	484.46(20.28)	−6.07(14.11)	−22.38(12.59)+	1.67(18.51)	732.36(9.23)	681.51(9.45)	712.7(10.04)	673.44(10.03)
IQ (composite standard score)	84.46(2.13)	−0.74(1.35)	0.62(0.8)	0.18(1.17)	89.89(0.92)	90.51(0.94)	89.15(0.98)	89.95(1)
FACES								
Average accuracy	0.75(0.03)	0.01(0.01)	na	na	na	0.76(0.01)	na	0.77(0.01)
Anger	0.74(0.04)	0(0.02)	na	na	na	0.71(0.02)	na	0.71(0.02)
Fear	0.78(0.05)	0.03(0.03)	na	na	na	0.74(0.02)	na	0.78(0.02)
Happiness	0.99(0.01)	0(0.01)	na	na	na	0.99(0)	na	0.99(0)
Sadness	0.51(0.05)	−0.01(0.03)	na	na	na	0.61(0.02)	na	0.61(0.02)
Peg Tapping, total correct	12.51(0.64)	−0.98(0.42)*	1.09(0.33)***	1.02(0.48)*	13.19(0.29)	14.29(0.3)	12.22(0.31)	14.34(0.33)

*$p < .05$

**$p < .01$

***$p < .001$

+$p < .10$