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Efficacy trial of the Second Step Early Learning (SSEL) curriculum: Preliminary outcomes

Carole C. Upshur [a,b,*], Miriam Heyman [a], Melodie Wenz-Gross [a,c]

[a] Department of Family Medicine and Community Health, University of Massachusetts Medical School, 55 Lake Avenue North, Worcester, MA 01655, USA
[b] Department of Quantitative Health Sciences, University of Massachusetts Medical School, 55 Lake Avenue North, Worcester, MA 01655, USA
[c] Department of Psychiatry, University of Massachusetts Medical School, 55 Lake Avenue North, Worcester, MA 01655, USA

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ABSTRACT

A classroom randomized trial ($n = 31$ classrooms) was conducted using the Second Step Early Learning (SSEL) curriculum compared to usual curricula. Head Start and community preschool classrooms enrolling low income children were randomly assigned to deliver SSEL ($n = 16$) or usual curricula ($n = 15$). Data are reported for four year olds independently assessed for executive functioning (EF) and social-emotional skills (SE) in fall and spring of the preschool year. Analyses used three level Hierarchical Linear Modeling, including two EF tasks or two SE tasks as level 1, child as level 2, and classroom as level 3. Controlling for baseline EF, SE, cognitive ability, parent income, child sex, age, and ethnicity, children receiving the SSEL curriculum had significantly better end of preschool EF skills and marginally significantly better end of preschool SE skills. The curriculum is thus promising in its potential to improve at-risk preschool children's EF and SE.

1. Introduction

Numerous recent studies have described the importance of early childhood social and emotional skills (SE) and executive functioning (EF) to longitudinal outcomes of child development, including social adjustment and academic performance in kindergarten and elementary school, and even longer term school attainment and adult functioning (Reynolds & Temple, 2008). Recently grouped together under the term self-regulation, these skills involve aspects of social behavior and neurocognitive regulation that include attention, regulating emotion/arousal, processing information, and the ability to engage positively with peers and teachers (Bierman, Nix, Greenberg, Blair, & Domitrovich, 2008b; Blair, 2002). These skills also seem to facilitate academic outcomes regardless of underlying general intelligence (Blair & Diamond, 2008). Further, current thinking is that moving beyond a focus on specific academic skills (e.g. counting, letter recognition) to promote school readiness by instead taking a developmental/psychobiological approach encompassing more fundamental regulatory processes will better promote children's capacity to learn, especially in the face of adverse sociodemographic stresses (Blair & Raver, 2015). This is affirmed by the emphasis kindergarten teachers place on the importance of social and behavioral skills for children entering formal schooling more so than specific math or prereading skills (Rimm-Kaufman, Pianta, & Cox, 2000).

1.1. Definition and relation of social-emotional (SE) and executive functioning (EF) skills

Social-emotional skills are typically defined by understanding and identifying emotions, perspective taking and ability to show empathy, reading and appropriately interpreting social cues, appropriately regulating emotional arousal, and social problem solving (Arsenio, Cooperman, & Lover, 2000; Carlo, Knight, Eisenberg, & Rotenberg, 1991; Crick & Dodge, 1994; Izard et al., 2001; Katsurada & Sugawara, 1998). Executive functioning skills in young children are typically defined by underlying behavioral regulation and cognitive attributes that include attention and attention shifting, working memory, and inhibitory control (Blair, 2002; Bierman et al., 2008b; Diamond, Barnett, Thomas, & Munro, 2007; McClelland et al., 2007; Morrison, Ponitz, & McClelland, 2010; Tominey & McClelland, 2011). However, there is strong evidence that EF and SE skills are interrelated and develop in a transactional manner over infancy and early childhood, influenced by interactions with the child's environment. Blair (2002) provides an extensive summary of the neurological and physiological underpinnings of the relation of emotion to cognition, pointing out that there are links between early infant physiological reactivity and later development of executive functioning and higher-order self-regulation that

* Corresponding author at: Department of Family Medicine and Community Health, University of Massachusetts Medical School, 55 Lake Avenue North, Worcester, MA 01655, USA.
E-mail addresses: Carole.upshur@umassmed.edu (C.C. Upshur), Miriam.heyman@umassmed.edu (M. Heyman), melodie.wenzgross@umassmed.edu (M. Wenz-Gross).

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are based in functional links in the brain between the limbic system and the prefrontal cortex. This brain connectivity has been confirmed by EEG studies in infants (Fox, Calkins, & Bell, 1994) and it is postulated that excess arousal due to either stressors in early childhood, or underlying biological over-reactivity, can overwhelm the regulatory capacity of the prefrontal cortex and impede the development of working memory, attention, and inhibitory control. This is one explanation for why young children experiencing early trauma and stress (such as due to poverty) may have less well developed EF skills.

There is also evidence that EF skills develop rapidly over the early childhood period and become increasingly complex with age. Diamond and Taylor (1996) assessed young children between ages 3.5 and 7 in two different working memory and inhibition tasks and found that younger children had more difficulty performing the tasks because of inability to hold two things in mind at once, or even if they remembered the instructions, were not able to prevent a prepotent response that was wrong. Blair (2002) points out that the skill to inhibit prepotent responses is the primary neurocognitive trait that is required for children to follow social norms such as waiting their turn. Denham, Bassett, Zinsser, and Wyatt (2014), in a study of 3- and 4-year olds also found EF skills such as inhibitory control, along with emotion knowledge, were the primary contributors to prosocial behavior and social problem solving skills in early childhood (other components of SE). Further, subsequent development of maladaptive social skills (e.g. aggression, hyperactivity, or withdrawal) in early childhood has been associated in a number of studies with earlier poor EF skills or lack of growth in EF skills (Hughes & Ensor, 2007, 2011).

In terms of research on SE, a group that has focused extensively on regulation of emotions as one component of SE, Eisenberg, Spinrad, and Eggum (2010) suggest that high negative emotionality in early childhood in turn prevents self-regulation, and leads to subsequent deficits in SE such as aggression and inability to follow rules (Campbell, Shaw, & Gilliom, 2000; Liu, 2004). While recognizing emotions, interpreting cues and other skills are also necessary, Eisenberg et al. emphasize what they call 'effortful control' as central to emotion regulation. They describe effortful control to include attention, cognitive flexibility, and ability to modulate a dominant response and have found an iterative and interactive development between emotion and self-regulation, indicating mixed evidence of the direction of effects. Like Blair (2002), they indicate that the relation is most likely transactional, as well as affected by genetic, epigenetic, parenting, and environmental influences. In fact, due to research on early neural plasticity, both Blair, and Eisenberg et al. suggest that interventions in the early childhood period, either with parents or in classrooms, can help children learn better emotion regulation through development of SE and EF skills.

1.2. Relation of SE and EF skills to school readiness and academic success

Various studies have demonstrated a link between preschool SE and EF skills and either concurrent or early school readiness and adjustment. For example, preschool emotion knowledge has been found to be predictive of directly assessed preschool children's cognitive competence (Garner & Waajid, 2012), teacher-rated academic success in kindergarten (Denham, Wyatt, Bassett, Echeverria, & Knox, 2009), directly assessed kindergarten literacy and numeracy (Torres, Domitrovich, & Bierman, 2015), and first grade academic and attention skills (Rhoades, Warren, Domitrovich, & Greenberg, 2011). In a model accounting for both EF and social-emotional skills, social problem solving in preschool was also significantly associated with kindergarten teacher ratings of both adjustment and academic readiness (Denham et al., 2014). Rhoades et al. (2011) however, found attention skills, a component of EF, to be a key mediator of the effect of emotion knowledge on subsequent academic skills.

Other studies have looked at EF skills and their relation to school readiness skills in preschool and kindergarten. There have been several studies reporting either higher cross-sectional scores, or growth in EF skills during preschool, including measures of working memory, attention and inhibition, associated with children's math, literacy, and vocabulary gains (McClelland et al., 2007; Montroy, Bowles, Skibbe, & Foster, 2014; Bierman et al., 2008a). Welsh, Nix, Blair, Bierman, and Nelson (2010) examined growth in aspects of EF (working memory and attention control) in Head Start children and found these to be associated with kindergarten math and reading levels. Baptista, Osorio, Martins, Verissimo, and Martins (2016) found similarly that end of preschool directly assessed executive functioning skills were associated with academic skills, although the relationship was fully mediated by teacher-rated social competence and behavioral adjustment.

Focusing specifically on attention skills as one dimension of EF, some longitudinal studies document outcomes well into school age and early adult years. For example, Duncan et al. (2007) found that attention skills at ages five and six predicted reading and math achievement through early adolescence. Another study found that parent-rated attention span persistence at age four was significantly associated with young adult reading and math skills, and college graduation by age 25 (McClelland, Acock, Piccinin, Rhea, & Stallings, 2013).

In understanding why EF skills may be associated with school readiness and academic achievement, work by Nesbitt, Farran, and Fuhs (2015) explored the mechanisms of this relationship. They found that EF skills fostered better learning related behavior in the classroom such as less disruptive or unoccupied time, better engagement in learning activities that require attention and multiple steps, and more cooperation with teachers and peers. These skills were in turn found to mediate the improvement in academic skills growth over the preschool year.

1.3. Importance of SE and EF interventions for at risk preschoolers

As the developmental literature has increasingly focused on the importance of SE and EF to adaptive child growth, it has also been recognized that some young children enter preschool with challenges in both these areas, particularly children from socioeconomic disadvantage (Ackerman, Brown, & Izard, 2004; Blair & Raver, 2015; Denham et al., 2012; Grimm, Steele, Mashburn, Burchinal, & Pianta, 2010; Phillips & Lonigan, 2010; Schultz, Izard, Ackerman, & Youngstrom, 2001; Sektnan, McClellan, Acock, & Morrison, 2010). For example, Sektnan et al. (2010) suggest that children in poverty, and children with other risk factors such as maternal depression, have limited opportunities to learn and practice EF, including aspects of planning and directing behavior, that are essential to positive classroom behavior due to unsafe environments and lack of early learning resources. They may also have increased allostatic load and less adaptive stress-response physiology that interfere with self-regulation aspects of EF (Blair, 2002; Blair & Raver, 2015). Nesbitt, Baker-Ward, and Willoughby (2013) in a sample of low and middle income children also found poorer EF skills in kindergarten among those with fewer resources and maternal education. However, Sektnan et al. (2010) suggest that those who have higher EF skills despite risk, have better academic outcomes, indicating the central importance of EF to academic achievement at early ages, and leading to suggestions that interventions to improve EF will decrease the children's SE deficits, since such children were over-represented achievement gap among at risk children (Blair & Diamond, 2008; Blair & Raver, 2015; Diamond & Lee, 2011; Farah et al., 2006). Similar arguments have been made to improve low income in a latent profile group characterized by poor emotion knowledge and self-regulation, and less prosocial and more aggressive social problem solving (Denham et al., 2012).

1.4. Rationale and study questions

In the last decade, as the research literature has revealed the importance of early SE and EF skills to school readiness, there have been various approaches to address development of these skills for children through early childhood classroom instruction. These interventions have shown some success in improving children's emotional and behavioral regulation, including directly assessed EF skills, such as attention and inhibition (Diamond et al., 2007; Raver et al., 2011), and children's SE skills such as emotional knowledge and social problem solving (Bierman et al., 2008a; Domitrovich, Cortes, & Greenberg, 2007). Diamond and Lee (2011), and Bierman et al. (2008b), have both pointed out that there are cognitive and behavioral dimensions of EF that are associated differentially with academic outcomes and social-emotional regulation, and interact with children's underlying temperament, motivation, and cognitive ability. Therefore they suggest a robust curriculum that addresses both SE and EF competencies in the context of a supportive learning environment will better foster regulatory skills that generalize to multiple learning situations, rather than specific instruction narrowly focused on EF.

The current study evaluates the efficacy of a recently developed curriculum, The Second Step Early Learning (SSEL) curriculum (Committee for Children, 2011); http://www.cfchildren.org/second-step/early-learning). SSEL builds on the knowledge and results of prior studies of development of SE and EF with young children. It explicitly incorporates instruction and activities that address both SE and EF, including emotion knowledge and regulation, perspective taking and empathy, and social problem solving skills, as well as attention, working memory, and inhibition. SSEL was based on a prior version of the curriculum (Committee for Children, 2002) that showed some success in improving preschool classroom climate and child behavior (Upshur, Wenz-Gross, & Reed, 2013), but did not include EF activities. The current version specifically incorporates a focus on EF by providing activities and games addressing attention, following directions, developing working memory, and inhibitory control, and has a greater emphasis on reinforcing skills across the school day. Activities in the new version are shorter and more varied, and include working with children in both large and small groups. A key feature of SSEL is that a weekly theme card provides scripted instructions and activities for each day of the week, and thus reduces teacher training and preparation time, an important point noted in other successful curricula (Domitrovich et al., 2007). The curriculum is already being widely disseminated, is of reasonable cost, and does not require teacher training from outside experts. However, these features are not useful unless the curriculum is able to impact child outcomes. There are so far no other published studies of SSEL outcomes. Thus the goal of the current study is to investigate potential efficacy of the curriculum on the proximal outcomes of EF and SE among at risk preschool children.

The data reported here focus on two major hypotheses: 1) children who receive teacher-delivered SSEL during the preschool year will have higher end of preschool EF skills than those not receiving the curriculum (controlling for entry to preschool SE and EF skills, general cognition, and demographics); and 2) children who receive teacher-delivered SSEL will have higher end of preschool SE skills than those not receiving the curriculum (controlling for entry to preschool SE and EF skills, general cognition, and demographics).

2. Methods

2.1. Study design

The study was a classroom randomized efficacy trial conducted in Head Start ($n = 18$ classrooms) and community preschools ($n = 13$ classrooms) that had state-subsidized slots, and served low income families, as well as children whose families were involved with protective services, or were homeless. Although some community preschools also served full fee, middle income families, they nevertheless had high proportions of nonwhite children (48% versus 75% in Head Start), families with incomes less than $20,000 (48% versus 69% in Head Start), and parents with a high school or less education (39% versus 56% in Head Start). Site-based demographic differences were controlled by random assignment to condition within site, resulting in 16 intervention and 15 control (curriculum as usual) classrooms. Classrooms participated for two years. For the current study, only data for four year olds were utilized. All programs/classrooms were accredited by the National Association for the Education of Young Children (n.d.) (https://www.naeyc.org/accreditation) and met state licensing standards. The study was approved by the Institutional Review Board of the University of Massachusetts Medical School.

2.2. Second Step Early Learning Curriculum (SSEL)

SSEL was developed as a commercial curriculum product by the Committee for Children (http://www.cfchildren.org/second-step/early-learning). It was designed to be developmentally appropriate for pre-k classrooms (4–5 year olds) although can also be used in mixed aged 3–5 year-old classrooms. It includes 28 weekly themes with different activities for all five days of the week, as well as theme-related songs and Brain Builder games intended to be played every day. Beyond the scripted daily activities, there are also suggested teaching strategies designed to reinforce skills, manage behavior, help children pay attention, encourage participation, and integrate learning the specific skills throughout the day. For example, each unit provides ideas to link weekly themes to other curriculum goals in literacy, math, science, and social studies so that the theme language, and teaching strategies are used in other activities. Teaching strategies described in the teacher manual to reinforce the daily themes include: 1) having children *think ahead* by asking them to think about times in the classroom when they could use the skill being taught; 2) ongoing *reinforcing* of skills by providing feedback to children who use the skills and modeling/coaching their use as situations arise during the day; and 3) *thinking back* to when the children used the skills and praising them for what they demonstrated. Other suggested teaching strategies involve providing specific reinforcement for positive behavior, having children give nonverbal agreement when asking group questions (e.g. pat your head if you agree the girl in the book is happy), telling children to use 'think time' to help with inhibitory control, and using random calling in group sessions which gives quieter children a chance to participate and also can reinforce those paying attention and sitting quietly. There is also a parent handout for each weekly theme, called Home Links, that describes what the children are learning and ways the parents can reinforce the themes at home.

There are five major units: 1) Skills for Learning (listening, focusing attention, using self-talk to remember and follow directions, and being assertive); 2) Empathy (identifying self and other's feelings, taking another person's perspective, and showing care and being helpful to others); 3) Emotion Management (understanding strong feelings, identifying one's own feelings when they are strong, and specific steps to calm down); 4) Friendship Skills and Problem Solving (how to join in play, inviting friends to play, fair ways to play, calming down and using problem solving steps to solve social problems); and 5) Transition to Kindergarten (reviews the program skills and concepts and helps children think ahead about using them in kindergarten). The Brain Builder Games, developed by the curriculum authors, teach EF skills that involve attention, following directions, and inhibitory control. Each game starts with a set of rules which can get more complex within the game as children learn to execute the motions, and the games get more complex over the course of the year. For example, Game 1 is called "Follow Along" and gives two initial rules: Rule 1; Watch what I do; Rule 2: Do the same thing (with suggested motions for the teacher to perform and have the children imitate). Game 11 is called "Partner Patty-Cake Walk" and has four rules: Rule 1: When I say 'go,' start stepping in place; Rule 2: When I say 'patty,' clap your hands; Rule 3: When I say 'cake,' clap your partner's hands up high; Rule 4; Keep stepping and clapping until I say 'stop.' Some games also have visual cues, like arrows or stop signs to connect words and symbols to actions. The Brain

Builder Games are meant to be practiced daily, integrated in various parts of the school day, and are suggested as particularly good for transition times.

The weekly themes are outlined on a large card with a picture showing a situation about the theme for the week on one side, and teacher instructions for daily activities given on the other side. The main daily activity is designed to be brief (5–7 min) and involves either the whole classroom or small group activities that use posters, songs, puppets, and story books. Day 1 is a script introducing the theme of the week using the puppets. Day 2 uses the picture on the curriculum card and provides a narrative for the teacher describing the situation on the card with questions for the children. Days 3 and 4 are reinforcing small and large group practice activities around the theme of the week, while Day 5 involves reading a book that also reinforces the theme of the week (e.g. different feelings, sharing, taking turns at play etc.).

2.3. Implementing the curriculum

SSEL curriculum kits along with a story book for each lesson were purchased by the study for the intervention classrooms and given to the classroom teachers. To assure a minimally adequate level of curriculum implementation to achieve the main aims of the study to establish potential efficacy, seven monthly two hour evening trainings were provided over the course of Year 1 to assist teachers in learning the curriculum and to support on-going implementation. In Year 2, since the same teachers were participating and had already implemented the curriculum for one year, the level of training support was intentionally phased down and only 5 large group trainings were conducted, during which there was more emphasis on teachers presenting to each other how the curriculum was going and ways in which they were connecting it to other daily activities. Teachers were paid overtime to attend the sessions, provided dinner, and received continuing education credits. Each intervention classroom was also visited once a month from November to May (Year 1) or October–May (Year 2) by study staff to observe one of the SSEL activities and to provide individual coaching and written feedback to the teacher(s) about how well they were implementing the curriculum. Coaching was conducted by the Principal Investigator (PI) and Co-PI, and core study staff. The PI and Co-PI received training and support from the Committee for Children, who in turn trained and supervised other core staff in conducting fidelity ratings, coaching, and writing up individual feedback to teachers.

Feedback covered eight areas, including: preparation; quality of delivery of the specific theme activity; Brain Builders and songs; using the SSEL teaching strategies; engaging and responding to children appropriately; managing children's behavior; using the SSEL reinforcing skills; how well the teaching team worked together; whether children were attentive or confused; and whether children generalized the skills in free play or spontaneously brought prior skills into current activities. Coaching involved discussing strengths and weaknesses, reviewing the proper way to deliver the various activities, addressing barriers to fitting in activities with other requirements, and suggestions on managing behavioral and attention problems of children. At each visit, a fidelity rating scale (not shared with teachers) was completed indicating how well the teachers were implementing the themes, activities (story, puppet, Brain Builder, song, book), the teaching strategies, and whether there was evidence in the classroom or activities of extensions/connections to other curriculum areas such as literacy, art etc. Written narrative feedback (not numerical ratings), regarding each of the categories on the fidelity rating scale, was given to the teachers after the visit.

Intervention teachers were asked to add the SSEL curriculum activities to their daily routines and to integrate SSEL activities with other curriculum requirements. Most of the classrooms used Creative Curriculum (Teaching Strategies, LLC, 2002–2012) because it was a state early childhood quality requirement (and thus the "usual" curriculum framework for the control classrooms). The remainder used Head Start frameworks (Department of Health and Human Services, Administration for Children and Families, 2011). SSEL provides information that specifically cross walks the Creative Curriculum goals and Head Start frameworks with SSEL activities to demonstrate the feasibility of integrating SSEL into ongoing programs.

2.4. Study recruitment and child assessment

Families were recruited for the study in the fall by site staff that completed university-required human subject protections training. All enrolled preschool children from age 3–5 were eligible to participate if the parent spoke English or Spanish. Only the four year-old child, if younger siblings were enrolled, or one child of twins, were retained in the study when families had more than one child in the participating classrooms. An informed consent process with written consent was completed on 91% of all children attending the participating child care sites. The two most frequent reasons for lack of study participation were parental language other than English or Spanish, and the child being in state custody.

Most classrooms enrolled both three and four year-old children, but only children who were four years old in September, or slated to enter kindergarten the following year, were individually assessed and reported in the current analyses. This was due to study resource constraints and the fact that the curriculum was specifically designed for 4–5 year olds. Children were assessed between September and mid-November and again between late March and end of May, by trained study research assistants (RAs) who were blind to study condition. RAs received 12 h of group training, several additional practice hours, and then 3–6 h of field-based training supervised by a trained staff member before being allowed to conduct assessments independently. Weekly review of completed assessments and ongoing supervision was provided. Assessments were administered over two days in two 30–45 minute sessions, with the primary individual SE and EF measures the focus of the current manuscript. Measures were not counterbalanced as in pilot testing we found that certain measures needed to be used consistently for warm up or interspersed for sustaining attention. Most of the assessments were completed in a corner of the preschool classroom, although at some sites the assessor was able to use a staff room separate from the classroom. All assessments were conducted in English. Children whose teachers indicated did not have adequate receptive or expressive language skills in English, even if parents consented ($n = 45$) were not assessed.

3. Measures

3.1. Curriculum implementation

3.1.1. Dose of curriculum

The number of weekly lessons, the portion of weekly activities completed, and the number of days Brain Games were played were documented by teacher self-report using a form developed by the Committee for Children (2011) for teacher implementation.

3.1.2. Fidelity of curriculum

A study developed observational rating scale consisting of 31 items in 8 categories (preparation for the lesson, delivery of the lesson, use of teaching strategies, engaging with children, managing children's behavior, use of reinforcing activities, involvement of the teaching team, and children's responsiveness) was completed at monthly observation visits using a five-point Likert scale with 1 = no observed implementation to 5 = frequent and effective implementation. Interrater reliabilities between pairs of study staff conducting the classroom visits were conducted for 15% of classroom observations over the two years. In Year 1 interrater reliability was 93% within one point (range 80%–100% for 24 paired observations), and for Year 2 was 94% within one point (range 84%–100% for 10 paired observations).

3.1.3. Observed curriculum implementation

A study developed observational tool, Social-Emotional and Executive Functioning Classroom Observation Tool (SEEF) was designed to be used in a random sample of both intervention ($n = 8$) and control ($n = 8$) classrooms in Year 2 to provide an independent measure comparing the relative frequency of teacher-led SE and EF activities in intervention and control classrooms. The scale was based on the "Adapted Teaching Style Rating Scale" developed for the Head Start Cares demonstration (Mattera, Lloyd, Fishman, & Bangser, 2013). RAs blind to study conditions and hypotheses observed each classroom for 2 h inclusive of a large group session/circle time and free play. They rated on a scale of 1–5 (never observed to frequently observed): 7 teacher-directed social skills (e.g. teacher describes how to identify and label feelings in a book or in a classroom situation; teacher gives specific techniques for calming down; teacher helps children learn social problem solving by demonstrating/encouraging playing together or trading toys when there is a conflict); 8 executive functioning skills (e.g. teacher gives specific ways for children to listen and pay attention in group; uses specific techniques with children to remember directions like self-talk); and 4 overall ratings of children's attentiveness, disruptiveness, prosocial behavior, and emotion regulation. Thirty percent of the observations were conducted by two RAs and interrater reliability was 100% within one point. Alpha reliability of the scale was 0.91.

3.2. Covariates

3.2.1. Demographics

At study enrollment, parents provided demographic information including the parents' marital status, education level, and family income. Parents also provided demographic information about the children including the child's sex, age, and ethnicity.

3.2.2. Cognitive ability

Assessors administered the Peabody Picture Vocabulary Test, 4th Edition (PPVT-4, Dunn & Dunn, 2007). This is a measure of receptive verbal ability that has been shown to correlate with measures of general cognition, and can be used as an indicator of general cognitive abilities of preschool children (Gullo & McLoughlin, 1982; Taylor, 1979). For each item, assessors presented children with four pictures and children were asked to identify the picture that represented a specific word (i.e., "point to the picture that shows *river*"). Standard scores were included in analyses as a cognitive control. Split half and alpha reliabilities are above 0.90, and the measure's average test-retest correlation is equal to 0.93 (Dunn & Dunn, 2007).

3.3. Executive functioning skills

3.3.1. Head-Toes-Knees-Shoulders

In the Fall and Spring, children completed the Head-Toes-Knees-Shoulders Task (HTKS) (McClelland et al., 2007). In this task, children were instructed to perform specific actions that were contrary to what the examiner said. In the first set of ten trials, children were instructed to touch their heads when the examiner said to touch their toes, and touch their toes when the examiner said to touch their heads. In the second set of ten trials, the same rules pertaining to heads and toes apply, and children must touch their shoulders when the examiner instructed them to touch their knees, and vice versa. In the third set of ten trials, the action of touching your head was paired with the command "knees" and vice versa, and the action of touching your toes was paired with the command "shoulders", and vice versa. This task requires three EF skills: inhibitory control, attention, and working memory. Children were given four practice trials with instructions repeated up to three times. In each of the three testing phases, children were given 10 commands, with possible scores of 0, 1, or 2 for each command (0 = incorrect; 1 = self-correct; 2 = correct response without a prior incorrect). The total score is the sum from each of the trials and is used as an indicator of executive functioning (range 0–60, with 20 points for each set of trials).

3.3.2. Backward Digit Span

The Backward Digit Span task was administered in the Fall and Spring as a measure of working memory (Davis & Pratt, 1996). Children were shown a puppet and told that the puppet likes to say everything backward. The examiner then said "1, 2" and had the puppet say "2, 1". Children were instructed to say things backwards like the puppet. Trials began with 2 digits and increased to 5 digits until children erred on three consecutive trials. The child's highest level of success was recorded (range = 1–5).

3.4. Social and emotional skills

3.4.1. Emotion Matching Scale

The short form of this 48-item measure (24 items) was used to measure emotion knowledge. It includes photographs of children with various emotional facial expressions, including happiness, sadness, anger, fear, and surprise (Izard, Haskins, Schultz, Trentacosta, & King, 2003). There were four parts where children were asked to: 1) match two expressions of the same emotion; 2) match emotions with situational cues, e.g., "show me the one who just got a nice new toy"; 3) produce emotion labels in response to pictures; and 4) use emotion labels expressed verbally by the tester to identify facial expressions. The Emotion Matching Scale (EMT) was designed for use with low income, ethnically diverse populations. It correlates well with other widely used measures of emotion knowledge and reliability for the shorter version is adequate ($\alpha = 0.72$–0.74; Seidenfeld, Johnson, Woodburn Cavadel, & Izard, 2014). In the current study, the total score was used as an indicator of emotion knowledge skills.

3.4.2. Challenging Situations Task

In the Challenging Situations Task (CST) children were presented with six drawings of common challenging social situations (e.g., having a block structure knocked down by another child, being hit by another child, having a ball taken away from them, etc.) and four drawings of possible responses to those situations, including prosocial, aggressive, crying, and avoidant responses (Denham, Bouril, & Belouad, 1994). For each challenging situation, the examiner described the situation shown in the situation picture and asked what the child would do if that situation happened to the child. The examiner then presented and labeled the response picture choices and asked the child to point to the one showing how the child would respond indicating their social problem solving skills. Children's prosocial responses have been shown to be related to emotion knowledge (Denham et al., 1994), and have increased following participation in a social emotional skills intervention (Bierman et al., 2008a). The proportion of prosocial responses, was used in the current study.

3.5. Data analysis

3.5.1. Preliminary analyses

Attrition analyses were conducted to determine if children lost to follow-up differed by intervention status. In addition, analyses were conducted to determine if there was adequate curriculum fidelity and if this was associated with Spring outcomes. Other analyses were conducted in order to investigate relationships between child and family characteristics and indicators of SE and EF skills (e.g., the two measures of SE-the EMT and CST Prosocial Score; and the two measures of EF-the HTKS and the Backward Digit Span). Except for baseline descriptives, analyses accounted for the multilevel nature of the data, with children nested within classrooms. Individual level bivariate correlations were used to analyze relationships between indicators of EF and SE skills within time points (i.e., in the Fall only) and across time points (from Fall to Spring). Individual level bivariate correlations were also used to explore relationships among EF and SE measures, and parental education, family income, child ethnicity, age, sex, and cognitive ability.

Effect size (ES) calculations provided an estimate of the impact of the intervention on individual measures of EF and SE, since the primary analyses utilized methods representing overall combined executive functioning and social-emotional skills. In order to calculate ES in the context of multilevel data, the following procedure was used for each indicator of EF and SE based on work by McCoach (2010) and Hedges (2007). A multi-level model was run with the EF or SE indicator as the outcome, and the condition (1 = intervention, 0 = control) as the only predictor. The regression coefficient associated with the condition was divided by the square of the sum of the student and classroom level variance components. This yielded an effect size estimate, which is comparable to *Cohen's d* (Cohen, 1988).

3.5.2. Primary analyses

In order to account for classroom variance in our primary analyses, we used two multilevel multivariate regression analyses to test the primary hypotheses: that the children in intervention classrooms, compared to children in control classrooms, would score higher on EF skills (taking into account the contribution of both EF measures) (Hypothesis 1) and SE skills (taking into account the contribution of both SE measures) (Hypothesis 2) in the Spring, after controlling for covariates including baseline performance in the Fall, baseline cognition, and child sex, age, ethnicity, and parent income. Parent income and education were significantly correlated, but parent income was more highly associated with the outcome measures, thus only family income was entered into the models.

To test the first hypothesis, that the intervention children would show higher EF skills at end of preschool, a three level model was used following procedures described by Hox (2010). Two measures of EF (HTKS and Backward Digit Span) comprise the first level, the child is the second level, and the classroom is the third. Covariates include baseline EF skills measured in the Fall, baseline SE skills measured in the Fall, Fall PPVT scores (centered around the mean of the sample as a measure of general cognition), as well as child sex, age, ethnicity, and family income. The condition is the primary predictor.

A similar three level model was used to test the hypothesis that the intervention would positively impact SE skills. The first level consists of the two measures of SE (EMT score, and the CST Prosocial score), the child is the second level and the classroom is the third. Covariates and predictors are the same as the ones utilized in the multilevel model predicting Spring executive functioning skills. All analyses were conducted using IBM SPSS Statistics for Windows, version 24.0.

4. Results

4.1. Sample

Table 1 contains the baseline characteristics for the 492 children in the sample. The children's average age at baseline assessment was 53.4 months (*SD* = 3.96), and approximately half of the children were of each sex (50.2% male). Less than half (47.4%) of the children were Anglo-American, 26.4% were African-American, and 38.8% were Hispanic-American. Children's mean PPVT standards scores represented a percentile rank of 41.08 (*SD* = 28.1), indicating overall cognitive skills somewhat below an age-equivalent population.

The majority of the parents were not married (74.1%). Approximately half of the parents (51.8%) had completed more than a high school education, and the majority of the families (60.8%) had family incomes less than $20,000.

A total of 85 children were excluded from primary analyses due to missing data in either the Fall or the Spring. Overall, children with missing data had parents that were significantly younger, had fewer years of education, and had lower family incomes than children with complete data. However, there were no statistically significant differences between intervention and control children in demographics or in the outcome measures at baseline for children with complete data and those who did not have complete data, except for the baseline Backward Digit score. Intervention children who were lost to follow-up scored significantly higher on this measure than did controls. We thus believe attrition had little effect on the results and if any impact, would underestimate EF outcomes since intervention children lost to follow-up were stronger on one component of EF than those who remained.

Table 1
Baseline characteristics of children and families.

	Whole sample (N = 492)[a]		Intervention (N = 252)		Control (N = 240)		*p*-Value
	%	n	%	n	%	n	
Child age in months mean (SD)	53.4 (3.96)	492	53.5 (3.96)	252	53.3 (3.96)	240	0.66
Child sex							0.79
Male	50.2	247	49.6	125	50.8	122	
Female	49.8	245	50.4	127	49.2	118	
Child ethnicity							
Anglo-American	47.4	233	54.0	136	40.4	97	0.003
African-American	26.4	130	21.8	55	31.3	75	0.019
Hispanic-American	38.8	191	34.5	87	43.3	104	0.052
Asian	1.8	9	2.4	6	1.3	3	0.51
Other	3.7	18	3.6	9	3.8	9	1.0
PPVT standard score mean (SD)	95.0 (14.9)	492	96.9 (14.4)	252	93.0 (15.2)	240	0.003
Parent education							0.817
<High school	13.5	65	12.6	31	14.3	34	
High school	34.8	168	34.6	85	35.0	83	
>High school	51.8	250	52.8	130	50.6	120	
Family income							0.349
<$10,000	30.6	147	31.8	78	29.4	69	
$10,000–$19,999	30.2	145	28.6	70	31.9	75	
$20,000–$29,999	20.4	98	18.0	44	23.0	54	
$30,000–$39,999	10.0	48	11.0	27	8.9	21	
$40,000–$49,999	3.5	17	3.7	9	3.4	8	
$50,000 +	5.2	25	6.9	17	3.4	8	
Marital status							0.18
Married	25.9	127	28.7	72	23.0	55	

[a] For some variables, n is not equal to 492. This is due to missing data or to participants indicating that they belong in more than category (i.e., child ethnicity).

4.2. Curriculum implementation

Overall there was fairly strong curriculum implementation, with almost all classrooms covering a substantial portion of the curriculum and achieving fidelity ratings indicating adequate quality of delivery of the planned curriculum activities. In Year 1 only 3 classrooms delivered fewer than the 25 core weekly lessons and they all completed 24 lessons. The remainder of the classrooms completed between 25 and 28 weekly lessons, with four completing all 28. Teachers reported delivering a mean of 87.1% (*SD* = 9.5) of weekly activities. In Year 2, 10 of the 16 classrooms completed all 28 lesson weeks, while all but one completed the 25 core lessons. Teachers also reported delivering 88.8% of weekly activities (*SD* = 10.8). Brain Games were reported by teachers as played 85.3 days (*SD* = 21.5, range 51–126) in Year 1, or on average 3.6 times a week. In Year 2 the mean days played was 95.8 (*SD* = 26.0, range 35–128), or on average 3.7 days a week. The mean independently observed fidelity rating for Year 1 was 3.58 (*SD* = 0.60, 2.74–4.51), and for Year 2 was 3.46 (*SD* = 0.45, range 2.48–4.21). Four classrooms in Year 1 and two classrooms in Year 2 did not meet the goal of achieving at least a mean 3.0 fidelity rating. There was no statistically significant difference between overall fidelity ratings in the two years and there were no significant correlations between the fidelity ratings and outcomes. Thus while there was some variation in implementation with and between years, it was not large enough to effect outcomes and was not explored further.

The SEEF observations revealed significant differences between curricular activities in intervention versus control classrooms, despite the small randomly selected sample of classrooms. Almost all the significant items were EF items, including attention and engagement ($p \leq 0.01$), thinking ahead and thinking back ($p \leq 0.01$), think time ($p \leq 0.01$), encouraging participation ($p \leq 0.01$) specific reinforcement ($p \leq 0.001$), and overall attentiveness ($p \leq 0.05$), all favoring intervention classrooms, with effect sizes > 1.0. In contrast, only one SE item significantly favored intervention classrooms, calming down ($p \leq 0.001$). There were no significant differences on identifying feelings, perspective taking, understanding strong emotions, social problem solving or friendship skills. Thus this measure seems to show more differences in the intervention classrooms on delivery of EF type activities than SE activities.

4.3. Preliminary outcome analyses

Table 2 contains individual level correlations between key outcomes and demographics. Correlations between the same measure at the Fall and Spring time points (i.e., the correlation between Fall and Spring measurements of HTKS) were moderate ($r = 0.35$–0.59). Within each single time point (Fall or Spring), correlations among measures ranged from 0.09 (correlation between Spring Backward Digit and Spring EMT scores) to 0.53 (correlation between Spring Backward Digit and Spring HTKS). Correlations at baseline and follow up between the outcome measures and parental education, parental marital status, and child sex were low ($r \leq 0.01$–0.13). Correlations were somewhat higher for child age ($r = 0.13$–0.33), for parental income, especially at follow-up ($r = 0.02$–0.16), and child ethnicity, again especially at follow-up ($r = 0.02$–0.27).

Table 3 shows baseline and end of year mean scores on the outcome measures as well as effect size analyses. Baseline scores on both EF and SE skills reflect the low income, high risk nature of the current sample. Comparing just Part 1 of the HTKS task, the current sample mean is 5.62 ($SD = 7.25$), while a mostly white and middle class sample of similar age preschoolers, scored 10.42 ($SD = 7.61$) (McClelland et al., 2007). A study of 47 middle class Anglo-American children using Backward Digit span as an indicator of EF (Carlson, Moses, & Breton, 2002) found a mean score of 1.58 ($SD = 0.79$) for 3 year olds and 2.2 ($SD = 0.86$) for four year olds, while in the current study the baseline sample mean is 1.15. In terms of SE skills, the current sample also scored on average lower on the EMT than a mostly Anglo-American university child care sample (54% versus 74% correct; Morgan, Izard, & King, 2009), and similar to a Head Start sample (54% versus 56%; Seidenfeld et al., 2014).

In the Fall, the intervention group scored higher than the control group on each indicator of EF and SE, with effect sizes ranging from 0.007–0.17. The final analyses accounted for this difference by including baseline scores as controls in equations predicting Spring outcomes. In the Spring, the intervention group again scored higher on each measure of SE and EF. Effect sizes were larger in the Spring, ranging from 0.03 to 0.35. In general, effect sizes were higher for EF measures (0.23 for Backward Digit Span and 0.35 for HTKS) than for SE measures (0.03 for EMT and 0.16 for CST Prosocial).

Table 3
Descriptive statistics for EF and SE measures by intervention and control[a].

Measure	Whole sample M (SD)	Control M (SD)	Intervention M (SD)	Effect size[b]
Fall				
HTKS[c]	8.69 (12.63)	7.08 (11.86)	10.02 (12.83)	0.17
Backward digit	1.15 (0.46)	1.15 (0.44)	1.16 (0.45)	0.007
EMT[d]	0.54 (0.14)	0.53 (0.15)	0.54 (0.16)	0.02
CST[e] prosocial	2.22 (1.59)	2.16 (1.59)	2.21 (1.64)	0.02
Spring				
HTKS	18.45 (17.00)	14.92 (16.37)	21.58(16.85)	0.35
Backward digit	1.33 (0.62)	1.22 (0.54)	1.42 (0.69)	0.23
EMT	0.64 (0.14)	0.63(0.13)	0.64 (0.13)	0.03
CST Prosocial	2.77 (1.73)	2.58 (1.62)	2.94 (1.81)	0.16

[a] Sample sizes vary across measures and time points. For the whole sample, $N = 453$–487 for Fall measures and 412–416 for Spring measures. For intervention, $N = 243$–262 for Fall and 219–221 for Spring. For control, $N = 210$–226 for Fall and 192–195 for Spring.
[b] The effect size was calculated by running multilevel models with each measure as the outcome and condition (intervention/control) as the only predictor. The effect size, a variant of Cohen's D, is equal to the regression coefficient for condition divided by the square root of the sum of the student and classroom level variance components. Standard deviation is computed as the square root of the total variance computed from a two level hierarchical linear model with no predictors.
[c] Head-Toes-Knees-Shoulders Task.
[d] Emotion Matching Task.
[e] Challenging Situations Task.

4.4. Primary outcome analyses

4.4.1. Executive functioning results

Table 4 shows the results from the multilevel model predicting the Spring EF skills. The coefficient representing baseline EF was positive and significant ($\beta = 0.66$, $p \leq 0.001$), as was the coefficient representing baseline SE skills (β 0.68, $p \leq 0.001$). Fall performance on the PPVT was also a significant predictor of Spring EF ($p \leq 0.05$), Child sex and parent income were not significant predictors, but greater child age at Time 1 was associated with better Spring EF skills ($p \leq 0.05$), and Hispanic ethnicity was associated with poorer Spring EF skills ($p \leq 0.05$). After accounting for the influence of the covariates, the coefficient representing

Table 2
Individual level correlations between key variables and child/family characteristics[a].

	CST[b] pro-social Fall	EMT[c] Fall	HTKS[d] Fall	Back-ward digit Fall	CST pro-social Spring	EMT Spring	HTKS Spring	Back-ward digit Spring	Condition[e]	Parental education	Family income	Fall PPVT	Child race[f]	Parent marital status[g]	Child age	Child sex[h]
Fall																
CST prosocial	–	–	–	–	0.35	0.12	0.26	0.24	−0.01	0.02	0.02	0.23	0.02	0.01	0.22	−0.03
EMT	0.23	–	–	–	0.18	0.49	0.38	0.26	−0.01	<0.01	0.06	0.46	0.04	0.01	0.33	0.09
HTKS	0.25	0.30	–	–	0.24	0.15	0.59	0.49	0.06	0.06	0.07	0.41	0.18	−0.14	0.26	<0.01
Backward digit	0.12	0.19	0.40	–	0.08	0.07	0.37	0.49	0.04	0.07	0.11	0.23	0.14	−0.08	0.14	0.02
Spring																
CST prosocial	–	–	–	–	–	–	–	–	0.08	0.06	0.11	0.18	0.15	0.07	0.13	−0.02
EMT	–	–	–	–	0.10	–	–	–	0.02	<0.01	0.08	0.21	−0.006	0.05	0.16	0.13
HTKS	–	–	–	–	0.26	0.17	–	–	0.15	0.09	0.16	0.44	0.27	−0.08	0.33	0.03
Backward digit	–	–	–	–	0.27	0.09	0.53	–	0.13	0.10	0.13	0.36	0.24	−0.03	0.25	−0.01

[a] p-Values are omitted due to their lack of validity in the context of individual level correlations with nested data.
[b] Challenging Situations Task.
[c] Emotion Matching Task.
[d] Head-Toes-Knees-Shoulders.
[e] 1 = treatment, 0 = control.
[f] 1 = Anglo-American, 0 = other.
[g] 1 = married, 0 = other.
[h] 1 = male, 2 = female.

Table 4
Multilevel model predicting executive functioning skills at end of preschool.

	Estimate	Standard error
Fixed effects		
Intercept	−13.34***	4.90
Time 1 EF[a]	0.65***	0.04
Time 1 SE[b]	0.68***	0.04
Time 1 PPVT[c] (centered)	0.06*	0.02
Child sex[d]	0.24	0.66
Child age Time 1	0.22*	0.09
Parent income	0.31	0.21
Asian-American[e]	1.53	2.50
African-American[e]	−1.53	0.80
Hispanic-American[e]	−1.77*	0.79
Other race[e]	1.16	1.72
Condition[f]	1.57*	0.67
Covariance parameters		
Residual	84.10***	4.26
Intercept (student)	<0.01	<0.01
Intercept (classroom)	<0.01	<0.01
Fit statistics		
−2 Log likelihood	5747.57	
AIC	5753.57	
BIC	5767.55	

* $p < 0.05$.
*** $p < 0.001$.
[a] Executive Functioning skills-representing both the Head-Toes-Knees-Shoulders Task and Backward Digit Span.
[b] Social Emotional skills-representing both the Emotion Matching Task and the Challenging Situations Task.
[c] Peabody Picture Vocabulary Test Standard Score - representing general cognition.
[d] 1 = male, 2 = female.
[e] 1 = named ethnicity, 0 = white.
[f] 1 = intervention, 0 = control.

Table 5
Multilevel model predicting social/emotional skills at end of preschool.

	Estimate	Standard error
Fixed effects		
Intercept	10,04***	2.01
Time 1 EF[a]	<0.01	0.02
Time 1 SE[b]	1.08***	0.02
Time 1 PPVT[c] (centered)	−0.06***	0.01
Child sex[d]	−0.12	0.27
Child age Time 1	−0.16***	0.04
Parent income	0.03	0.09
Asian-American[e]	−0.05	1.02
Hispanic-American[e]	−0.49	0.30
African-American[e]	0.18	0.33
Other race[e]	0.41	0.70
Condition[f]	0.54+	0.30
Covariance parameters		
Residual	13.82***	0.71
Intercept (student)	<0.01	<0.01
Intercept (classroom)	0.13	0.19
Fit statistics		
−2 Log likelihood	4341.49	
AIC	4347.49	
BIC	4361.46	

[a] Executive Functioning skills-representing both the Head-Toes-Knees-Shoulders Task and Backward Digit Span.
[b] Social Emotional skills-representing both the Emotion Matching Task and the Challenging Situations Task.
[c] Peabody Picture Vocabulary Test Standard Score - representing general cognition.
[d] 1 = male, 2 = female.
[e] 1 = named ethnicity, 0 = white.
[f] 1 = intervention, 0 = control.
\+ Condition was marginally significant at $p = 0.08$.
*** $p < 0.001$.

the condition was positive and significant ($\beta = 1.57, p \leq 0.05$). This provides support for the hypothesis that the intervention significantly contributed to the development of children's EF skills compared to children not receiving the intervention.

4.4.2. Social-emotional skills results

Table 5 shows the results from the multilevel models predicting the Spring SE skills. Fall SE skills were positive and significant ($\beta = 1.08, p \leq 0.001$). The coefficient representing performance on the PPVT was negative and significant ($\beta = -0.06, p \leq 0.001$), while none of the demographic variables significantly predicted Spring SE except child age. Younger children had significantly better Spring SE skills, controlling for baseline, than did older children ($\beta = 0.16, p \leq 0.0001$). Finally, the coefficient representing participation in the intervention was positive and marginally significant ($\beta = 0.54, p = 0.08$). Because the significance is marginal, this provides tentative support for the hypothesis that the intervention contributed to children's gains in social and emotional skills over control children not receiving the curriculum. The significant and negative coefficient for baseline PPVT is puzzling. We attribute this finding to covariance among baseline cognition, SE and EF, since removing baseline EF and SE from the model results in a larger, positive, and still significant coefficient for baseline PPVT.

5. Discussion

Development of both social-emotional (SE) and executive functioning (EF) skills in the preschool period is important to early school success, as well as positive elementary school, adolescent, and adult functioning (Blair & Diamond, 2008; McClelland et al., 2013; Rhoades et al., 2011). Yet children from disadvantaged environments in terms of income, parental education, or minority ethnicity appear to enter preschool behind in these skills (Grimm et al., 2010; Nesbitt et al., 2013; Sektnan et al., 2010). Sektnan et al. point out that risk factors such as poverty and maternal depression in early childhood prevent practice with behavioral regulation. Blair and Raver (2015) indicate early childhood risk factors create the potential for an abnormal stress-response physiology, that in turn impacts the self-regulatory skills, such as focus and goal oriented behavior, necessary for social and academic performance. EF also predicts end of year teacher social skills ratings (Duncan et al., 2007), indicating the connection of EF to social adaptation and regulation that also promote classroom behaviors conducive to learning.

On the other hand, while there is a physiological and perhaps genetic, component to self-regulation, regulatory skills can be affected by environmental changes. Thorell, Lindqvist, Nutley, Bohlin, and Klingberg (2009) and Rueda, Posner, and Rothbart (2005) both have demonstrated that lab-based training of 4 and 5 year olds on working memory and effortful control/attention tasks show learning improvements that are generalizable to other tasks, including general IQ measures. Effects were also detectable in measures of reaction time and electroencephalography. Duncan et al. (2007) also demonstrated that the trajectory of low income Head Start children's EF could be affected by a preschool curriculum.

The current study evaluated a new curriculum (Second Step Early Learning-SSEL, Committee for Children, 2011), that was designed to influence both SE and EF skills as complementary components of behavioral regulation, among a mostly low income and at risk preschool population served by Head Start and community child care classrooms. Controlling for baseline skills and cognitive ability, demographics, and accounting for nesting within classrooms, we found a significant impact for the intervention condition (SSEL delivered by the classroom teacher) on end of preschool EF skills above and beyond baseline skills. This effect held even when the model was tested with the addition of child age, sex, ethnicity, and family income, although Hispanic children seemed to have fewer gains in EF over the school year than did White children. The effect size analysis of individual components of EF demonstrated that the HTKS task, measuring attention, working memory, and inhibition, contributes to more of the change than does the Backward

Digit Span, which has only a working memory and not an inhibition component.

In contrast, the intervention estimate for SE outcomes was only marginally significant. Child sex, ethnicity, and parent income also did not account for the end of year SE skills, although younger children made more gains. The impact on prosocial problem solving (CST Prosocial) was stronger, although with a small ES, than for emotion knowledge (EMT), for which there was a negligible difference between intervention and control children. We attribute the weaker effects of the curriculum on SE to the strong emphasis of SSEL on EF skills which are not typically taught in preschool classrooms, combined with control classrooms in this study also addressing SE skills. This was confirmed by our SEEF measure which was an unbiased observation of a sample of both intervention and control classrooms in Year 2, which found stronger differences favoring intervention classrooms for EF activities and weaker differences for SE activities (particularly identifying feelings and perspective taking). Most of the classrooms in the current study used other standardized curricula such as Creative Curriculum (Teaching Strategies, LLC, 2002–2012), which provide a framework to cover important skill development for children over the course of the preschool years, including a set of goals for social development. Head Start guidelines also include goals for social emotional development (U.S. Department of Health and Human Services, Administration for Children and Families, 2011). Thus, control classrooms implemented "curriculum as usual," that clearly included activities related to social/emotional development.

In terms of covariates, we did not find family income differences in Spring outcomes for EF or SE skills as have been found in other studies (McClelland et al., 2007). This may be because our sample was primarily low income. Further, while there were baseline differences in children's skills, and these contributed to Spring EF scores, the intervention was still significant in boosting children's EF above and beyond preschool entry general cognition (PPVT), EF and SE skills. Baseline SE, but not baseline EF skills, were significant predictors of Spring SE skills, although general cognition (PPVT) and child age were negatively related and also significant, suggesting it's possible that younger children and those with lower preschool entry general cognition benefitted more in development of their SE skills. We also found Hispanic children did poorer in EF outcomes. Generally this has not been reported in other similar preschool intervention studies (e.g., Bierman et al., 2008a) and may be due to the power derived from a larger proportion of Hispanic children in this study.

Finally, we found no sex differences in outcomes. This is consistent with other intervention studies of early childhood samples (McClelland et al., 2007; Bierman et al., 2008a). While young boys may more often be categorized into higher risk groups for social problem solving and regulatory problems compared to girls (Denham et al., 2012), and preschool girls may develop self-regulation skills earlier (Montroy, Bowles, Skibbe, McClelland, & Morrision, 2016), the current and other interventions designed to improve SE and EF skills seem to equally benefit girls and boys when controlling for baseline skills (Bierman et al., 2008a).

While having considerable strengths, including independent assessment of children's outcomes, confirmation of fidelity of implementation, and some independent data documenting control classroom curriculum, there are some weaknesses to the study. As a classroom randomized study, we used analytical techniques to account for classroom variation and clustering, which nevertheless may be a somewhat weaker design than randomization at the individual child level. In addition, due to the time needed to assess all children before classes ended in the early summer, some children were assessed before they received all weeks of the curriculum. This is a common method in classroom intervention studies, but may underestimate the full effect of receiving all weeks of the curriculum. Further, all classrooms were National Association for the Education of Young Children (NAEYC) accredited (https://www.naeyc.org/accreditation) and were state licensed, with adequate overall quality indicators, and thus baseline levels of instruction before adding the experimental curriculum were high. In other comparisons (e.g. to children not attending preschool, or not attending as high a quality settings) the differential effects of SSEL might be stronger. Finally, the focus of the study was specifically on establishing efficacy, and therefore a higher level of training and coaching was provided to teachers in order to assure a minimally adequate dose of the curriculum was achieved, and we did not have primary study questions around implementation issues. This level of support might not be possible in routine use of the curriculum and further study is necessary in order to document outcomes with broader dissemination.

Despite these limitations, this is one of the few studies of preschool curricula that enrolled both Head Start classrooms/children and community–based private preschools, allowing for generalizability of study findings to a more diverse set of preschool programs. Since there is a great need for evidence-driven curricula that can promote both EF and SE, we believe that these preliminary findings show promise for this relatively new curriculum, especially with regard to the development of EF. Further dissemination and evaluation of SSEL will help build evidence for its impacts, and potential to improve SE as well as EF skills in preschool children.

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