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**EMOTION KNOWLEDGE AS A MEDIATOR OF
SCHOOL READINESS OUTCOMES**

A Thesis in

Psychology

by

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Abstract

OBJECTIVE: Developmental conceptualizations of emotional competence have distinguished emotion knowledge from emotion regulation. Several theoretical models suggest that the acquisition of emotion knowledge supports the development of emotion regulation, as well as enhancing child school readiness in both cognitive and behavioral domains. However, empirical research directly testing these temporal associations remains limited. This study examined the predicted associations in the context of an experimental intervention that used a social-emotional learning program to enhance children's emotional competence and school readiness. The first goal of this study was to examine the longitudinal associations between emotion knowledge and emotion regulation from preschool to kindergarten and determine whether the intervention influenced those associations. The second goal was to determine whether intervention effects on emotion knowledge mediated intervention effects on kindergarten readiness outcomes in areas of academic performance, learning behaviors, and social adjustment. **METHOD:** Participants were 356 children (17% Latinx, 25% African American, and 58% European American; 54% girls; $M_{\text{age}} = 4.59$ years at initial assessment) recruited from 44 Head Start classrooms. Emotion knowledge was measured through direct assessments; emotion regulation was assessed with parent and teacher ratings. **RESULTS:** Emotion regulation at the start of the preschool year was marginally predictive of emotion knowledge at the end of that year; emotion knowledge at the end of the preschool year was marginally predictive of emotion regulation in kindergarten. Emotion knowledge significantly mediated the effects of explicit SEL intervention on academic performance, prosocial behaviors, and aggressive behaviors, over and above the contributions of emotion regulation.

CONCLUSIONS: The findings underscore the utility of examining emotion knowledge as a distinct construct of emotional competence with unique contributions to early school adjustment.

Keywords: Emotion knowledge, emotional competence, school readiness, social-emotional learning

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Introduction

Children growing up in poverty are more likely than their economically advantaged peers to enter school with delays in areas of language and emergent literacy skills, as well as delays in areas of adaptive learning behaviors and social-emotional competencies (Gershoff, Aber, Raver, & Lennon, 2007; Hair et al., 2006; Morrissey & Vinopal, 2018). The educational disparities associated with this early disadvantage often grow over time, as children who begin schooling with fewer readiness competencies steadily fall behind their more ready peers, graduating from high school at lower rates and often suffering life-long underemployment (La Paro & Pianta, 2000; Lee & Burkam, 2002; Lemelin et al., 2007).

Developmental research emerging over the past two decades suggests that a key factor undermining the school readiness of children growing up in poverty is the negative impact of early adversities on children's emotional development. The ecological characteristics associated with poverty often expose young children to unpredictable and potentially threatening environments characterized by high noise levels, overcrowding, and poor-quality living conditions, along with elevated levels of family instability, family conflict, and exposure to violence (Wadsworth, 2015). These stressors contribute to the frequent activation of the hypothalamic-pituitary-adrenal (HPA) axis, which serves as one of the body's core stress response systems (Blair & Raver, 2012). At a physiological level, threat exposure elicits and reinforces emotional arousal and reactive "fight or flight" responses rather than more planful, problem-solving focused emotion self-regulation (Evans & English, 2013). Developmentally, chronic activation of the HPA during early childhood impedes the neurodevelopment of the

prefrontal cortex, which plays a key role in supporting the regulation of emotions, attention, and behavior (Blair & Raver, 2015). As a result, preschool children growing up in socio-economically disadvantaged circumstances often show lower levels of emotional competence than their more advantaged peers, including less well-developed understanding of their own and others' emotions (emotion knowledge [EK]) and a lower capacity for managing their emotions (emotion regulation [ER]).

Accumulating research documenting the negative impact of early adversity on stress responding and emotional development has sparked interest in the design and evaluation of social-emotional learning interventions for preschool children, hoping that these interventions might promote emotional competence and thereby enhance school readiness and elementary school success (Bierman & Motamedi; Jones & Bouffard, 2012; McClelland, Tominey, Schmitt, & Duncan, 2017). Several preschool social-emotional learning programs include explicit instruction designed to increase EK (Bierman & Motamedi, 2015), based on the hypothesis that growth in EK may remediate some of the deficits associated with early disadvantage, support the development of ER, and play a key role in fostering later school performance in both cognitive and non-cognitive domains (Izard et al., 2001).

The conceptual models that identify EK as a foundational skill for school readiness are supported by longitudinal studies that have demonstrated delays in EK and ER skills among children growing up in poverty, and have linked preschool levels and preschool growth in EK with later academic and social-emotional functioning. Although passive longitudinal studies are consistent with the conceptual models, an experimental test is needed to make stronger causal inferences.

The purpose of this study was to test a causal model of the role of preschool emotion knowledge (EK) in boosting concurrent emotion regulation (ER) and subsequent kindergarten adjustment in the context of a randomized intervention trial serving children from low income families, the Head Start *Research-based Developmentally Informed* (REDI) classroom program. The study explored REDI intervention effects on the developmental dynamics of EK and ER during the course of the preschool year and evaluated the unique associations between EK and later school adjustment (academic performance, adaptive learning engagement, and social-emotional adjustment) while accounting for concurrent ER.

The Role of Emotional Competence in School Readiness

As noted, growing up in poverty is often associated with elevated exposure to chronic stressors that over-activate the HPA axis and impede the development of the prefrontal cortex and associated self-regulatory capacities (Blair & Raver, 2015). Being able to effectively manage the stressors associated with poverty may depend heavily on developing emotional competence. Within the context of school readiness, emotional competence encompasses both: 1) the ability to process and accurately identify different emotional expressions and understand the social contexts associated with different emotions (i.e., emotion knowledge, EK), and 2) the effective management of behavioral responses to strong emotions, (i.e., emotion regulation, ER). EK and ER are distinct processes (Izard et al., 2011); theorists have argued that EK may support the development of ER and also uniquely facilitate children's school readiness outcomes in domains of academic competence, learning behaviors, and social behaviors (Denham, 2006; Izard et al., 2001).

Emotion knowledge. EK is defined as the ability to attend to emotionally-relevant information in the environment, accurately identify emotional experiences and expressions, and

understand the situations that elicit specific emotions (Izard et al., 2001). EK is comprised of two interrelated skills: expression recognition (e.g., the ability to correctly identify emotional expressions) and emotion situation knowledge (e.g., understanding the kinds of situations likely to elicit different discrete emotions, and the ability to infer other's emotions based on situational cues). The developmental paths of expression recognition and emotion situation knowledge are intertwined; as children become able to distinguish and label basic feelings such as sadness and anger, they can link these labels with the different antecedent conditions, subjective feelings, and behaviors commonly associated with these different feelings. The feeling labels become part of their mental representations of social-emotional scripts (e.g., emotional schema) that comprise their knowledge about the situations and events associated with different feelings (Bassett, Denham, Mincic, & Graling, 2012).

Because EK represents the internalization of emotion display rules, improves cause-and-effect understanding, and enables self-reflection and perspective taking, some have argued that EK functions as the interface between emotion and cognition (Ackerman, Abe, & Izard, 1998). Supporting this model, longitudinal analyses suggest EK supports key aspects of cognitive development in early childhood. For example, Blankson and colleagues (2012) found that EK at age 3 years predicted cognitive development at age 4 years in domains including working memory, inhibition, and early perspective taking. In turn, proficiency in these cognitive skills facilitates classroom learning, which could explain the associations documented in preschool between EK and academic achievement (Denham et al., 2012). Several studies have found that higher levels of EK measured at the start of the preschool year facilitate greater achievement in early literacy and math, as well as mastery of basic conceptual knowledge and language

development by the end of the preschool year (Denham, Bassett, Brown, Way, & Steed, 2015; Denham, Bassett, Zinsser, & Wyatt, 2014; Garner & Waajid, 2012).

Researchers have also speculated that growth in EK contributes to more focused and adaptive learning behaviors in preschool. In part, this may be because being able to accurately identify their own feelings allows children to conserve attentional resources allocated to self-regulation. That is, the process of identifying an emotion transforms the sensory and physiological sensations associated with that feeling into higher order thought processes that help children reduce their arousal level and conserve attentional resources (Izard, 2007). Children with more well-developed EK are also more efficient in processing the emotional displays of other children, as well as more able to retrieve the situation knowledge that guides their appraisal and response to their peer's emotional reactions (Izard, 2007). Relative to children with less EK, children with greater EK may spend less time and mental effort on labeling and making inferences about emotional cues (Bahrick, Krogh-Jospersen, Argumosa, & Lopez, 2014), allowing them to devote more attention to learning tasks (von Salisch, Denham, & Koch, 2017). Consistent with this hypothesis, greater EK at the beginning of the preschool year is associated with more focused and adaptive learning behaviors (attentiveness, task persistence, interest in learning, and rule compliance) by year's end (Bassett, Denham, Mincic, & Graling, 2012; Shields, et al., 2001). Rhoades and colleagues (2011) also found that preschool EK predicted children's ability to sustain attention during a repetitive task and examiner ratings of children's task persistence, attention span, and attention to directions in kindergarten.

EK is also implicated in promoting positive social interactions and interpersonal decision making. Being able to identify others' emotional expressions helps children appraise others' motivations and thoughts; knowing what situations are associated with different feelings

provides further context to help children make inferences about other's mental states and informs their behavioral responses (Lemerise & Arsenio, 2000). In this way, greater EK may improve perspective taking and lead to greater empathy towards others, which facilitates prosocial behaviors (Eggum et al., 2011). Children who are better able to understand expressions and emotion-related context cues in preschool are also more likely to respond in a prosocial manner; this tendency towards cooperation, helpfulness, and conformity to rules makes them more well-liked by peers during kindergarten (Sette, Spinrad, & Baumgartner, 2017). Conversely, EK deficits are associated with social aggression and context inappropriate expressions of anger (Denham et al., 2002). As a result of their aversive interaction styles, angry/aggressive children with poorer EK tend to have impaired social functioning, as they are viewed unfavorably by peers and teachers, experience more peer rejection, feel lonelier, and show more self-isolation (Locke, Miller, Seifer, & Heinze, 2015; Schultz, Izard, Ackerman, & Youngstrom, 2001).

Emotion regulation. Emotion regulation refers to the ability to modulate the physiological arousal associated with emotion and effectively manage or control one's behavioral reaction (Keltner & Gross, 1999; Denham & Brown, 2010). In preschool a key developmental task involves the capacity to inhibit impulsive reactions to emotions such as anger, frustration, or distress in order to form adaptive responses (Thompson, 1991; Thompson & Goodman, 2010). This becomes a particularly important skill once children enter the preschool classroom where they are expected to follow classroom rules, share resources and cooperate with peers, take turns and wait in line (Denham & Brown, 2010).

Emotion regulation skills may play a central role in allowing children to control aggressive and disruptive behaviors and to resolve interpersonal conflicts and maintain positive relationships (Eisenberg, Fabes, Murphy, Maszk, Smith, & Karbon, 1995; Fabes, Eisenberg,

Karbon, Troyer, & Switzer, 1994). Studies have linked higher levels of effective ER in preschoolers with teacher-rated socially competent behaviors and more positive peer nominations both concurrently (Raver, Blackburn, Bancroft, & Torp, 1999) and prospectively when children enter kindergarten (Denham et al., 2003).

Better ER in preschool also predicts less impulsive-disruptive behavior and better learning behaviors (e.g., staying focused, planning and finishing activities) in kindergarten (Howse, Calkins, Anastopoulos, Keane, & Shelton, 2003). By helping children inhibit impulsive and reactive behavior and by promoting focused, on-task learning, ER may also facilitate children's academic achievement. Consistent with this speculation, preschoolers who begin preschool with greater ER evidence greater academic gains by year's end than children with low ER (Raver, Garner, & Smith-Donald, 2007; Shields, Dickstein, Seifer, Giusti, Magee, & Spritz, 2001). Similarly, parent-rated ER in preschool (Howse, Calkins, Anastopoulos, Denham, & Shelton, 2003) and kindergarten (Graziano et al., 2007) predicts kindergarten literacy achievement and teacher ratings of academic competence.

Pathways Between Emotion Knowledge and Emotion Regulation

Differential Emotions Theory explicitly separates EK and ER into distinct processes and suggests that the acquisition of EK provides a developmental foundation for emerging ER (Izard et al., 2011). Similarly, Eisenberg and colleagues (2005) have proposed a theoretical model that posits that EK is the antecedent to ER, which is associated with more socially competent behaviors that increase academic motivation and predict academic achievement.

The facilitation of ER by EK occurs in part as a function of the direct modulation of physiological arousal that occurs when a child is able to identify and label the feeling they are experiencing. In addition, the enhanced capacity to recognize emotional expressions and the

increased knowledge of the situations associated with specific emotions allows them to more accurately predict and interpret their own experiences and the experiences of others (Izard et al., 2000). Hence, children with greater EK are better prepared to identify and select behaviors that are responsive to the situation and produce more desirable outcomes (Garner & Power, 1996; Hughes, Dunn, & White, 1998). Furthermore, as children enact different behavioral strategies, EK processes may allow them to better recognize which ER behaviors are more effective at helping them attain the various goals they may hold (Izard et al., 2000). For these reasons, it is suggested that the acquisition of EK enables children to bridge the gap between automatic response styles and more conscious, planful ER strategies (Izard et al., 2011).

Consistent with this hypothesis, Cole and colleagues (2009) measured preschool children's EK and ER (e.g., coded behaviors during a frustration task) concurrently, and found that greater EK was associated with more adaptive ER. Garner and Power (1996) also found that in preschoolers, greater EK was associated with greater up-regulation of positive emotions during a laboratory frustration paradigm. Similarly, Miller and colleagues (2006) found that preschool EK was associated with teacher-rated ER. Although these studies established correlational links between the two constructs, the cross-sectional designs precluded true predictive analysis. Using longitudinal data, Denham and colleagues (2012) compared regression models that used preschool EK to predict kindergarten ER (e.g., behavioral coding of classroom observations) and models that used preschool ER to predict kindergarten EK. Their analysis found significant results only for the pathway from preschool EK to kindergarten ER (Denham et al., 2012).

A few studies with non-confirmatory findings are worth noting. Blankson and colleagues (2012) found that there were no predictive paths between EK and ER (e.g., maternal report and

observations of frustration task) assessed in preschool and later in kindergarten. Schultz and colleagues (2001) did not examine the predictive pathway from preschool EK to kindergarten ER, but found support for the alternative prediction from preschool ER to kindergarten EK.

However, two studies offer additional support for the hypothesis that EK precedes and supports ER. In a cross-sectional study with kindergarten children, Di Maggio, Zappulla, and Pace (2016) found that EK was positively associated with teacher-rated ER which, in turn, mediated the association between EK and teacher-rated prosocial behaviors. Similarly, Denham and colleagues (2012) found that preschool ER (e.g., observed behavior) mediated the association between preschool EK and kindergarten teacher ratings of learning behaviors.

Preschool SEL Interventions and Emotional Competence

Research demonstrating links between children's preschool emotional competence and later school adjustment and attainment has fueled the design and evaluation of preschool social and emotional learning (SEL) interventions (Jones & Bouffard, 2012). Given evidence that gradeschool SEL interventions have demonstrated efficacy in areas of improved social behavior, adaptive learning, and enhanced academic achievement (Durlak, Weissberg, Dymnicki, Taylor, & Schellinger, 2011), SEL programs have been designed to extend downward developmentally. Several of these programs focus explicitly on teaching children EK (see reviews by Bierman & Motamedi, 2015; McClelland et al., 2017).

For example, the *Preschool PATHS Curriculum* (Domitrovich, Greenberg, Cortes, & Kusche, 1999) includes specific lessons on EK. Children are provided with "feeling faces" that illustrate core emotions (such as happy, sad, mad, scared, excited, and frustrated) in line drawings. In formal lessons, teachers discuss with children what someone looks like (face and body) when they feel that way and what situations lead to that feeling. Children are encouraged

to use their own feeling faces during the day to exhibit and talk about their feelings. Teachers model feeling talk, and discuss feelings throughout the day, when reading stories or reflecting on the day's events. PATHS also teaches children specific strategies for calming down and managing strong feelings. After taking a deep breath to calm down, children are encouraged to "say the problem and how they feel." Using these strategies PATHS hopes to strengthen children's EK as an antecedent to and support for effective ER.

Several other well-established preschool SEL programs similarly include explicit efforts to teach young children EK such as the Second Step Program, preschool level (McMahon, Washburn, Felix, Yakin, & Childrey, 2000) and the Emotions-Based Prevention Program (Izard et al., 2008). However, a number of other preschool SEL programs do not include an explicit EK focus. Instead, these other programs rely on more implicit strategies (positive teacher management and support strategies) to support children's emotional development. For example, the *Incredible Years Teacher Training Program* (Webster-Stratton & Hammond, 1997) focuses on helping teachers use positive classroom management strategies to create safe, secure, and predictable contexts to nurture children's social and emotional competencies.

Conceptually, an explicit preschool SEL program may have greater impact on EK than a program that does not teach EK explicitly, which in turn may facilitate improvements in preschool ER and future improvements in kindergarten school adjustment and academic performance. Exposure to an explicit preschool SEL program may be especially beneficial for children from low-income families who enter preschool with relative deficits in EK and ER and may need specific instruction in EK and ER skills to more successfully adapt to a formal school environment. The case for explicit EK-focused intervention would be strengthened by experimental evidence that improvements in EK promote improvements in ER and account for

preschool intervention effects on targeted school outcomes of social competence, adaptive learning behaviors, and academic performance.

Study Aims

The present study used the randomized-controlled trial of the Head Start REDI program to evaluate the role of preschool EK growth in promoting later school adjustment in the context of active intervention efforts to promote EK. Prior research documented a significant REDI intervention effect on EK growth during the preschool year (Bierman et al., 2008); this study examined how those intervention boosts in EK may have affected ER during the preschool year and several dimensions of school adjustment after the transition into kindergarten.

The first aim of the study was to analyze the longitudinal bidirectional associations between EK and ER over the course of the preschool year and determine whether an explicit SEL program affected those dynamic associations. Based on the available literature, it was hypothesized that EK would facilitate growth in ER over time (Cole et al., 2009; Denham et al., 2012; Garner & Power, 1996). Bi-directional effects from ER to EK were also explored, although this direction of effects was not expected given the lack of conceptual reasons for expecting ER to promote EK and the limited empirical evidence that it does so (Schultz et al., 2001). It was anticipated that intervention would promote EK growth during the preschool year, but not fundamentally alter the dynamic association between EK and ER. The second aim of this study was to test the theory-based hypothesis that intervention effects on EK will mediate later effects on kindergarten school adjustment in areas of academic competence, learning behaviors, and social competence. ER was explored as a second potential mediator in these models. Based on prior conceptual models and longitudinal evidence (Leerkes et al., 2008; Garner & Waajid,

2012), it was hypothesized that EK would serve as the primary mediator for later academic outcomes and that ER might serve as an additional mediator of the behavioral outcomes.

Method

Participants

Participants included 356 children (17% Latinx, 25% African American, and 58% European American; 54% girls; $M_{\text{age}} = 4.59$ years at initial assessment). They were recruited from 44 Head Start classrooms in Pennsylvania, located in three counties participating in the REDI program, representing a range of urban and rural regions of the state. Over two successive years, children were recruited through study brochures that were distributed to all parents of children who qualified for kindergarten the following year; 86% enrolled in the study. Most participating families had incomes that were below the federal poverty limit (median annual income = \$18,000). At the conclusion of the preschool year, participants transitioned into 202 kindergarten classrooms at 82 schools in 33 school districts.

Initially, classrooms were stratified on location (county), length of program (half-day or full-day), and student demographics (% non-white) and then randomized to the intervention or control condition. Classrooms in the same center were always assigned to the same condition, to avoid inadvertent contamination of condition within centers. Racial composition was comparable across intervention and control groups (39% of minority students in the intervention group and 45% in the control group). In addition, the proportion of students who had attended a Head Start program the year prior (approximately 60%) was fairly evenly spread across the intervention and

control conditions. The average classroom size was about 14 students (1/3 of whom were aged 3, and 2/3 of whom are aged 4).

At the kindergarten follow up, 97% of the original participants were retained. Missing values were estimated using Full Information Maximum Likelihood.

The Head Start REDI Intervention

The Research-Based, Developmentally Informed (REDI) intervention is a curriculum-based intervention delivered by teachers. The intervention programming was integrated into ongoing Head Start classroom programs that were using either High/Scope or Creative Curriculum as their base curriculum, and incorporated curriculum components and teaching strategies designed to promote social-emotional learning and early language and literacy enrichment. Teachers completed 4 days of training workshops and received support in weekly mentoring sessions by REDI trainers.

The Preschool PATHS Curriculum (Domitrovich, Greenberg, Cortes, & Kusche, 1999) served as the foundation of the REDI program, which was designed to facilitate mastery of emotional competence in the following domains: emotion knowledge and communicating about feelings, emotion regulation, interpersonal problem solving, and prosocial friendship skills. Following well-specified lesson plans, teachers used puppet characters, role-play demonstrations, and photographs as props in story modeling and discussions throughout the 33 weekly lessons. One lesson and one extension activity were implemented each week, which included group presentations/discussions followed by interactive, play-based extension activities (e.g., group games, cooperative art projects) to reinforce social-emotional concepts and provide opportunities to practice prosocial skills. Lessons in the feelings module utilized these strategies to explicitly introduce and review feelings, and included emotion coaching to help children learn to recognize

and label feelings internally and for others. Lessons in the friendship module incorporated explicit instruction, teacher modeling, class discussion, and in-class practice of cooperative, prosocial skills such as sharing, taking turns, and helping. Through the self-regulation module, teachers modelled the steps of a behavioral regulation strategy (i.e. “doing turtle”) that included stopping a behavior that was causing excessively disruptive emotions, going into the turtle shell (e.g., hugging themselves), taking a deep calming breath, and clearly stating the problem and emotion(s) they were experiencing. Practice of self-regulation was continually reinforced as teachers remind children to practice “the turtle” in moments of emotional arousal.

The REDI program also incorporated interactive reading, in which teachers were trained to use open-ended questions, story discussion, and participatory story-retelling to encourage children to remember and process story details to increase their comprehension. The books used in these reading lessons were selected to synchronize with the PATHS themes and included discussions of emotions and social problem-solving, providing additional reinforcement for explicit emotions learning.

Intervention fidelity was assessed via teacher’s weekly self-report on 10 questions assessing adherence to the lesson and children’s engagement with activities ($\alpha = .87$). A 3-point Likert scale was used. Teachers’ average weekly rating score was 2.78 ($SD = 0.15$), which indicates that teachers perceived themselves as demonstrating high fidelity and that students generally understood the curriculum. Once a month, REDI trainers also rated teacher’s program fidelity and quality of implementation using a 6-point Likert scale. Average quality ratings were as follows: PATHS, $M = 4.6$ ($SD = 0.74$), interactive reading, $M = 4.39$ ($SD = 0.57$), and overall REDI program, $M = 4.55$ ($SD = 0.67$). Scores of 4-5 corresponded to ratings of “adequate” to

“strong” performance. Overall, the intervention was delivered with reasonably high fidelity and quality of instruction.

Data Collection Procedures

Parents who indicated interest in the study were visited in their homes where informed consent was acquired. During that visit, parents provided demographic information and ratings of their child’s behavioral adjustment (September – October; T1). Parents were subsequently visited at home to provide similar ratings at post-intervention at the end of the prekindergarten year (May – June; T2), and at a follow-up assessment near the end of the kindergarten year (May; T3).

After parent consent was acquired, baseline child assessments were scheduled at school (September – October; T1). A trained research assistant met with each child during two half-hour individual sessions scheduled outside of the classroom to administer the direct assessments. The same procedure was followed at the end of the year (April-May; T2), and for the follow-up assessments during the spring semester of kindergarten (March-April; T3). In kindergarten, this was a single 45-minute assessment.

Head Start teachers were provided with rating scales to complete on their own and return to the project. Ratings were completed independently by the lead and assistant Head Start teachers at the beginning (October; T1) and at the end of the prekindergarten year (May; T2). Kindergarten teachers were asked to provide similar ratings at the end of the kindergarten year (April; T3). All teachers provided their informed consent to serve as ratings. Parents and teachers were compensated financially for their time providing ratings. The study was completed in compliance with the ethical standards of the American Psychological Association and the approval of the university IRB.

Measures of Emotion Competence

EK. The expression recognition component of EK was measured using the *Assessment of Children's Emotion Skills* (ACES; Schultz & Izard, 1998). Children were asked to identify the feelings shown in 12 photographs of racially diverse children displaying different basic expressions such as happiness, sadness, fear, and anger, or no feeling. Children received a score of 0 if they chose the incorrect emotional label, and a score of 1 if they chose the correct label. The scores were summed for a total ACES score ($\alpha = .57$). The ACES measure has been used extensively in low income preschool populations (Domitrovich, Cortes, & Greenberg, 2007; Schultz et al., 2001; Izard et al., 2001; Parker, Mathis, & Kupersmidt, 2013). Children's emotional situation knowledge was assessed using the *Emotion Recognition Questionnaire* (ERQ; Ribordy, Camras, Stefani, & Spaccarelli, 1988). The measure consists of 16 vignettes that were read aloud (e.g. "Johnny's/Susie's little brother broke his/her favorite toy on purpose"). After each vignette, children were shown four faces displaying happy, mad, sad, or scared faces and asked to identify what emotion the child in the story was feeling. Children received a score of 0 if they chose the incorrect emotion, and a score of 1 if they chose the correct emotion and these were summed for a total score ($\alpha = .63$). Scores on the two scales were standardized and averaged to create an EK score ($r = .42, p < .001$). It is commonly used in assessments of low income preschool children's social-emotional development (Krueckeberg, Kapp-Simon, & Ribordy, 1993; Martins, Osório, Veríssimo, & Martins, 2016; Sicotte, 2013; Weiland & Yoshikawa, 2013).

ER. Children's ability to cope with difficult emotions was measured using the emotion regulation subscale from the *Social Competence Scale* (Conduct Problems Prevention Research Group, 1995). On a Likert-type scale from 1 (Almost never) to 6 (Almost always), the teacher and assistant teacher rated children on items such as "Copes well with

disappointment or frustration”, “Accepts things not going his or her way”, “Controls temper when there is a disagreement”, and “Stops and calms down when frustrated or upset”. Head Start lead and assistant teachers rated children independently and their scores were averaged to generate a final score for teacher-based assessment of emotion regulation ($\alpha = .92$, $r = .57$, $p < 0.001$).

Measures of Kindergarten Outcomes

Academic competence. Kindergarten academic outcomes were assessed with teacher ratings and direct assessments of child literacy skills. Teachers completed the 6-item *Academic Performance Questionnaire* (APQ; Bierman et al., 2008) with questions such as “What is the quality of this child’s reading skills?”, “How quickly does this child learn new material or pick up novel concepts?”, and “Please rate the student’s mathematical skills in comparison with grade-level expectations at your school” on a rating scale from 1 (Far below grade level) to 5 (Far above grade level). Responses were summed to create a total APQ score ($\alpha = .85$). In addition, children’s early literacy achievement was evaluated using the Test of Word Reading Efficiency, which measures children’s phonemic knowledge and word attack skills (Torgesen, Wagner, & Rashotte, 1999). In the Sight Word Efficiency subtest, children are tasked with reading as many sight words as possible aloud in 45 seconds. In the Phonemic Decoding subtest children sound out as many phonetic nonsense words as they can in 45 seconds. The two subtest scores were summed to create an overall TOWRE score ($\alpha = .96$). The teacher ratings score and literacy achievement score were then standardized and averaged to create an Academic Competence composite score ($r = .69$, $p < 0.001$).

Adaptive learning behaviors. Adaptive learning behaviors were assessed with teacher ratings and observation ratings. Kindergarten teachers rated children’s adaptive classroom

participation using a 14-item measure that was developed for the REDI project (Bierman et al., 2008). Using a scale from 1 (Strongly Disagree) to 6 (Strongly Agree), teachers rated children's learning engagement (e.g., "Appears happy and engaged at school"; "Seems enthusiastic about learning new things"; "Is ready for the cognitive demands of school") and academically relevant regulation (e.g., "Can follow the rules and routines that are part of the school day"; "Can work independently"; "Is able to sit at a table and do work"). Responses were summed to create a total score ($\alpha = .97$). Adaptive learning behaviors were also assessed using a 13-item version of the Adapted Leiter-R Assessor Report (Roid & Miller, 1997). After completing direct assessments, examiners used a scale from 1 (Not Much) to 4 (Very Much) to rate children's attentiveness (e.g., "Pays attention to instructions and demonstrations"; "Careful, interested in accuracy"), task engagement (e.g., "Sustains concentration; willing to try repetitive tasks"; "Cooperates; complies with examiners requests"), and demonstrated interest (e.g., "Shows pleasure in accomplishment and active task mastery"; "Confident") during the assessments. Responses were summed to create a total score ($\alpha = .77$). Teacher rating and observer rating scores were standardized and averaged to create a Learning Behaviors composite score ($r = .50, p < 0.01$).

Social-emotional competence. The prosocial behavior sub-scale from the *Social Competence Scale* were used to measure children's cooperativeness and appropriate regulation of behavior in a social context. Parents ($\alpha = .85$) and kindergarten classroom teachers ($\alpha = .94$) rated children on a scale from 1 (Almost never) to 6 (Almost always) on behaviors such as "Shares with others", "Resolves problems with other children on his or her own," and "Listens to other people's point of view". Teacher and parent ratings were summed across items and then standardized and averaged to create an overall prosocial behavior rating ($r = .32, p < 0.001$). Teachers and parents also rated children on the Authority Acceptance subscale of the *Teacher*

Observation of Child Adaptation-Revised (Werthamer-Larsson, Kellam & Wheeler, 1991) which tapped verbal and physical aggression and rule-breaking behaviors. Parents ($\alpha = .86$) and kindergarten classroom teachers ($\alpha = .89$) rated children on a scale from 1 (Almost never) to 6 (Almost always) on behaviors such as “Breaks things on purpose”, “Knowingly breaks rules,” and “Fights with other children”. Teacher and parent ratings were summed across items and then standardized and averaged to create an overall aggressive behavior rating ($r = .37, p < 0.001$).

Covariate Measures

The Expressive One-Word Picture Vocabulary Test (EOWPVT) was used to control for the effects of children’s verbal ability on school readiness outcomes (Gardner, 1990). The EOWPVT is a test of expressive vocabulary, in which children are shown illustrations of objects and activities and asked to generate single word labels ($\alpha = .93$). Demographic variables including child gender, age, and maternal education were included as covariates.

Plan of Analysis

The analyses proceeded in three steps. First descriptive analyses were undertaken to examine the simple associations between EK and ER during prekindergarten and their correlations with the kindergarten outcomes. Next, to address the first aim of the study, a cross-lagged panel was used to analyze the longitudinal bidirectional associations between EK and ER over the course of preschool and kindergarten. Invariance of that model across the intervention and control conditions was evaluated to determine whether the REDI intervention affected those dynamic associations. Then, path analytic models were fit to address the second aim of this study and test the theory-based hypothesis that intervention effects on EK mediated later effects on kindergarten school adjustment in areas of academic competence, learning behaviors, and social competence. These models considered ER as a second potential mediator in these models, both

to control for ER when testing the models of EK impact, and to identify potential contributions of ER on kindergarten outcomes. Control variables include child age, gender, verbal ability, maternal education, and pre-treatment measures of the outcomes. Kindergarten outcomes were assessed after participants transitioned from the participating Head Start classrooms into 202 kindergarten classrooms at 82 schools in 33 school districts. For this reason, nested analyses were not performed. Bootstrapped confidence intervals were used to test mediation. Analyses were conducted using the SPSS Statistics 25 AMOS package and MPLUS 7. Missing values were estimated using maximum likelihood estimation. For ease of interpretation, all variables were standardized, such that means were set to 0 with a standard deviation of 1.

Results

Descriptive Analyses

Bivariate correlations were conducted to assess associations between pre- and post-intervention measures of EK and ER (T1 and T2). Surprisingly, there were no significant concurrent or predictive associations between measures of EK and ER during the prekindergarten year. A single marginal predictive association emerged later, as post-intervention EK (T2) was marginally correlated with kindergarten ER (T3).

Additional bivariate correlations between measures of emotional competence and kindergarten school outcomes are presented in Table 3. EK and ER were both significantly correlated with all school outcomes. Greater EK scores at the start and end of the preschool year (T1 and T2) were significantly associated with greater academic competence, more adaptive learning behaviors, increased prosocial behaviors, and decreased aggressive behaviors in the spring of the kindergarten year (T3). Similar results were found for ER, with greater ER scores at the start and end of prekindergarten year significantly predicting increased academic

competence, more adaptive learning behaviors, increased prosocial behaviors and decreased aggressive behaviors in kindergarten. The Fisher Z -Transformation was used to test the difference in the magnitude of the correlations linking EK versus ER to kindergarten outcomes. One significant difference was found: EK was more strongly associated with later academic competence ($r = .37$) than was ER ($r = .13$; $Z' = 3.17$, $p < .01$).

EK and ER Associations Across the Prekindergarten Year

To address Aim 1, a three-wave cross-lagged panel design was computed (Burkholder & Harlow, 2003). Analyses were conducted using SPSS 25 and AMOS 25, utilizing maximum likelihood estimates for missing data. Path analysis was used to analyze the longitudinal bi-directional associations between EK and ER over the course of prekindergarten year (T1 – T2) and prediction to ER in kindergarten (T3); EK was not measured in kindergarten. As suggested by Byrne (2004), the invariance of this model across the intervention and control conditions was tested by using a chi-square difference test compared the constrained model (all paths set the same across the intervention and control condition) with an unconstrained model (all paths freely estimated and allowed to vary across conditions). This test was non-significant, $\chi^2(6) = 1.94$, $p = .93$, indicating the model was invariant across intervention and control conditions. The strength of the autocorrelated paths for EK and ER and the cross-lagged paths between EK and ER were not significantly different across intervention conditions.

Because invariance in these paths was found across control and intervention groups, the whole sample of children across both conditions was used for the final cross-lagged panel ($CFI = .99$, $TLI = .90$, $RMSEA = .10$). As expected, the autocorrelations of EK and ER showed stability over time. Contrary to our hypothesis, there was no significant cross-lagged effect from EK at prekindergarten fall to ER in spring of the same year. A marginally significant cross-lagged

effect was found from ER at prekindergarten fall to EK in prekindergarten spring, $\beta = .08$, $SE = .05$, $p = 0.09$. A marginally significant association also emerged between EK and ER over the transition from prekindergarten to the kindergarten year, as EK assessed during the spring of prekindergarten was marginally predictive of ER assessed in the spring more than a year later, $\beta = .09$, $SE = .05$, $p = 0.06$.

Testing EK and ER as Intervention Mediators of Kindergarten Outcomes

To address aim 2, path analyses were conducted using structural equation models with manifest variables to estimate the extent to which EK and ER simultaneously mediated the association between explicit SEL intervention and kindergarten outcomes. Path analysis was used to test fully saturated models (i.e., with zero degrees of freedom). In a fully saturated model where all possible paths and correlations are estimated, fit statistics cannot be evaluated and the model is assumed to fit the data perfectly. Four saturated models were tested, with each kindergarten outcome modeled separately. Standardized parameter estimates are presented in Figure 1. All analysis controlled for gender, verbal ability, and T1 estimates of EK and ER.

Each of the following models shows the same impact of intervention on EK and ER. Intervention had a statistically significant impact on promoting EK at the end of the prekindergarten year, $\beta = .24$, $SE = .09$, $p < 0.01$, but no significant impact on promoting ER, $\beta = .11$, $SE = .07$, $p = .12$. The first model included academic competence as the kindergarten outcome (Figure 2). EK at the end of prekindergarten was significantly positively predictive of academic competence in kindergarten, $\beta = .22$, $SE = .06$, $p < 0.01$; ER was not. A significant indirect effect, tested using bootstrapped standard errors, was found for intervention on academic outcomes through the influence of EK, $\beta = .05$, 95% CI [.02, .12], $p < 0.05$.

The second model included learning behaviors as the kindergarten outcome (Figure 3). EK at the end of prekindergarten was marginally positively predictive of kindergarten learning behaviors, $\beta = .12$, $SE = .07$, $p = 0.08$; ER was not. There was no significant indirect effect for intervention on learning behaviors through EK.

The third model included prosocial behaviors as the kindergarten outcome (Figure 4). EK at the end of prekindergarten was significantly positively predictive of kindergarten prosocial behaviors, $\beta = .18$, $SE = .06$, $p < 0.01$; the prediction of ER to prosocial behaviors was also significant, $\beta = .16$, $SE = .07$, $p < 0.05$. A significant indirect effect was found for intervention on prosocial behaviors through EK, $\beta = .02$, 95% CI [.01, .10], $p < .05$.

The final model included aggressive behaviors as the kindergarten outcome (Figure 5). EK at the end of prekindergarten was significantly negatively predictive of kindergarten aggressive behaviors, $\beta = -.17$, $SE = .06$, $p < 0.01$. Similar results were found for ER, $\beta = -.20$, $SE = .07$, $p < 0.01$. A significant indirect effect was found for intervention on aggressive behaviors only through EK, $\beta = -.04$, 95% CI [-.10, -.01], $p < .05$.

Discussion

Preschool SEL interventions seek to promote growth in children's emotional competence skills to offset the developmental and environmental disadvantages of economic hardship and enhance children's school adjustment. However, it is unclear how growth in different aspects of emotional competence (EK and ER) affect each other over time and the role they play as mediators of preschool intervention effects on later kindergarten adjustment.

Developmental models of emotional competence distinguish between EK and ER and posit that EK is foundational for developing later ER capacities (Izard et al., 2011; Eisenberg et al., 2015). However, empirical evidence for this hypothesis has been mixed, with some studies

finding support for this direction of association (Cole et al., 2009; Denham et al., 2012; Garner & Power, 1996) while others have found evidence for the opposite direction – ER fostering growth in EK (Schultz et al., 2001). In the context of a SEL preschool intervention involving explicit lessons in EK, this study examined the developmental associations linking EK and ER and tested the hypothesis that EK would serve as the primary mediator of intervention effects on kindergarten adjustment outcomes. Compared to prior studies that assessed EK and ER associations with cross-sectional or longitudinal data, the randomized design of this intervention trial provided a stronger basis for assessing the role of EK in later school adjustment and the benefits of intervening to strengthen EK skills in preschool.

The first aim of the study was to determine the extent to which EK and ER exhibited bidirectional influences over the span of preschool and kindergarten.

The second aim of the study was to determine the extent to which EK mediated the effects of a preschool SEL intervention on kindergarten behavioral and academic school readiness outcomes. The REDI intervention had a significant impact on gains in EK during the preschool year, which in turn mediated the effects of intervention on three key kindergarten outcomes (academic competence, increased prosocial behavior, and reduced aggression) over and above the effects of ER. Preschool EK was also associated with kindergarten learning behaviors, and preschool ER was associated with kindergarten prosocial and aggressive behaviors, but none of these associations served as significant mediators of the preschool intervention effects. These results emphasize the need to treat EK as a separate dimension of emotional competence from ER. Furthermore, the findings suggest that specifically targeting EK may be helpful for promoting kindergarten adjustment in low-income populations.

Relation between EK and ER

The first aim of the study was to determine the extent to which EK and ER exhibited bidirectional influences over the span of preschool and kindergarten, and to test the hypothesis that EK provided foundational support for the development of ER. The results of the present study provided little support for the theorized developmental association between EK and ER. Surprisingly, during the prekindergarten year there were no significant correlations between EK and ER at either the beginning or end of the year. These findings suggest that EK and ER may be quite independent aspects of emotional competence at this age, and each may have distinct etiological factors. For example, researchers have speculated that ER in prekindergarten-aged children is quite heavily influenced by temperamental patterns of reactivity. The role of EK in supporting “top-down” cognitive control of emotional reactivity through processes involving reappraisals and higher order cognition are just beginning to emerge at this age (Blair, 2002). By placing these results in the context of the developmental span, it may be the case that EK and ER begin as relatively independent processes that do not meaningfully cross over until the early elementary school years. Consistent with the present findings, a cross-sectional study assessing preschool students also revealed no significant correlations between EK and ER (Garner & Waajid, 2012). Similarly, Denham and colleagues (2003) found no significant associations between EK and ER (e.g., maternal ratings and observational coding of coping behavior to frustration) as assessed in prekindergarten. Finally, in a longitudinal study conducted by Blankson and colleagues (2012) over the course of the prekindergarten year, no bi-directional influences emerged; instead EK and ER grew independently of one another.

In the present study, the hypothesized association emerged later with marginal significance, as prekindergarten EK marginally contributed to kindergarten ER ($p = .06$). The shift from prekindergarten to kindergarten commonly coincides with the age range in which

rapid development occurs in children's cognitive faculties (Best & Miller, 2010). Prior research has also shown that compared to their younger peers, older preschool children evidence greater EK capacities (Denham et al., 2012; Garner & Waajid, 2012). Fine, Izard, and Trentacosta (2006) have also demonstrated that EK undergoes continual growth in the period from early elementary school through to middle school. That the marginally significant EK to ER path emerged during this specific time period suggests that kindergarten may mark the point at which cognitive abilities for most children may be reliably drawn upon for emotionally relevant reappraisal and decision making. In the case of EK, such cognitive development includes skills such as theory of mind, understanding cause-and-effect, and perspective taking. Hudson and Jacques (2014) found that at ages 5 to 7, greater EK was associated with greater efforts to regulate negative emotional displays during a disappointing gift paradigm. Longitudinal findings from Trentacosta and Izard (2007) that EK (e.g., expression recognition and situation knowledge) in kindergarten predicted teacher-rated ER in first grade provide tentative support for the assumption that the contribution of EK towards the development of ER becomes more solidified past prekindergarten. These studies suggest that the hypothesized association between EK and ER may emerge in the early elementary grades -- a later developmental time point than studied here.

Although predominant emotion theories anticipate that EK should support ER over time (Izard et al., 2011; Eisenberg et al., 2015), a few researchers have argued for the reverse effect in which ER may facilitate the growth of EF through the efficient management of emotional arousal that might otherwise distract or overwhelm limited attentional resources (Blair et al., 2015). This study also revealed a marginally-significant path from ER to EK during the preschool year. Although one must be cautious about over-interpreting a marginally significant effect, it is

possible that preschool ER development frees up cognitive resources during emotionally-challenging situations in the preschool context, increasing children's capacity to direct more attention to other's emotional cues and associated antecedents. Consistent with this interpretation, Schultz and colleagues (2001) found that caregiver-rated temperamental indicators of ER in prekindergarten predicted expression recognition and situation knowledge in kindergarten.

Another factor that may account for variation in findings across studies has to do with the assessment of ER. Across studies of young children, EK is measured in fairly similar ways, by having children identify feelings from photographs or pictures (expression recognition), and/or by having children identify the feelings in events, stories, or puppet shows (situation knowledge). In contrast, ER is measured in a large variety of ways. In this study, ER was measured using prekindergarten teacher's end-of-year impressions of how well children managed emotionally-challenging situations (e.g., "Copes well with disappointment or frustration"; "Controls temper when there is a disagreement"; "Accepts things not going his or her way"; "Stops and calms down when frustrated or upset"). Some researchers including Miller and colleagues (2006) also utilize teacher-rated ER, whereas others such as Denham and colleagues (2012) assess ER through classroom observations of regulated behavior. Another common operationalization of ER is via behavioral coding of child emotional and behavioral responses to frustrating laboratory tasks. For instance, Cole and colleagues (2009) defined ER as effective behavioral responses to a frustration paradigm, while Garner and Power (1996) measured ER as the frequency of positive or negative emotional expressions as children completed similarly frustration-inducing tasks. Much of the prior research that showed stronger associations between EK and ER used more discrete measures of ER that incorporated specific behavioral coding scheme of target behaviors

with a narrower band of behaviors being assessed. In contrast, the teacher ratings of ER used in this study might instead be capturing more global patterns of emotionally regulated behavior that may span across different modalities of expression and be drawn from repeated observations of a wide range of emotionally challenging situations. Teacher ratings such as these provide important information about long-term, repeated behavioral trends. However, due to their more diffuse nature, they may not be as sensitive to more subtle or incremental changes in ER behavior compared to laboratory measurements.

Overall, the conflicting evidence as to the specific direction of growth in emotional competence skills, as well as the presence of findings that suggest EK and ER are independent processes during the initial prekindergarten phase of development, makes clear that further research is necessary. Many extant studies comparing EK and ER utilize cross-sectional data or use models that anticipate that EK precedes and support ER rather than conducting bidirectional analyses at each time point. By using a cross-lagged design that separates EK from ER, this study contributes to the literature on emotional development in early childhood by providing a more fine-grained longitudinal assessment of growth in different emotional competence skills across time.

Intervention Effects on Emotional Competence Pathways

This study also examined whether an explicit SEL intervention that incorporated emotion coaching would change the associations between EK and ER across the prekindergarten period. Although intervention promoted significant gains in EK, it did not change the longitudinal associations among the measures. The PATHS explicit emotion coaching curriculum may have effectively “raised all boats”, demonstrating its utility as a universal school-based intervention

that can benefit at-risk populations who tend to enter prekindergarten with deficits in EK as well students who may be more developmentally mature in this domain.

Emotion Knowledge as a Mediator of Kindergarten Outcomes

The mediational path models in this study demonstrated that children who participated in the intervention had significantly greater EK scores at the end of prekindergarten, controlling for pre-intervention levels. In contrast, there were no significant intervention effects on children's ER. Taken together, these results suggest that the REDI intervention with its explicit SEL instruction prospectively predicted greater emotional competence at the end of prekindergarten primarily via effects on expression recognition and emotional situation knowledge. It may be that boosting EK showed more change because it was a proximal effect that was directly targeted in explicit SEL instruction, whereas changes to ER patterns of behavior may be more multiply-determined and take more time to manifest. As a discrete skill that can be more directly augmented through deliberate instruction, emotion knowledge emerges as a critical point of intervention particularly as the results of this study demonstrate that EK acts as an important driver of post-intervention academic and social-emotional adjustment. Consistent with our hypothesis, EK mediated the association between intervention participation and kindergarten academic competence, prosocial behaviors, and aggressive behaviors, even after controlling for the effects of ER, gender, age, verbal ability, and maternal education. Children who were better at accurately labeling emotional expressions and showed greater understanding of emotional cause-and-effect by the end of prekindergarten evidenced greater pre-literacy skills and were rated by teachers as showing greater academic mastery at the end of kindergarten. This may be due to the effects of EK development on refinement of cognitive skills that are necessary for academic achievement. Discrete Emotions Theory argues that EK is not merely a function of

either emotional experience or cognitive thought-processing, but rather represents a point of convergence that embodies core aspects of both systems (Ackerman, et al., 1998). Because EK embodies fundamental capacities that enable both self-regulation and executive function, growth in this domain may have broad impact on both cognitive and social-emotional adjustment. Prior research has shown that EK develops in an interdependent way with fundamental cognitive capacities including working memory, inhibitory control, and theory of mind, which may explain the link between EK and children's academic success in kindergarten (Blankson et al., 2012; Denham et al., 2012).

Additionally, children with greater gains in EK skills were also significantly more likely to interact with other children in cooperative, socially appropriate ways. They were also significantly less likely to behave aggressively. It can be assumed that the ability to accurately assess social emotions provides information that is necessary for children to be able respond constructively and further their goals. Deficits in EK may lead to misinterpreting social cues and result in inappropriate behavioral responses (Denham et al., 2002). Children who are easier to anger also tend to interpret others' social cues as angry; these hostile social attributions are associated with higher levels of aggressive behaviors (Locke, Miller, Seifer, & Heinze, 2015; Orobio de Castro, Merk, Koops, Veerman, & Bosc, 2005; Schultz, Izard, & Bear, 2004). On the other hand, children who, through preschool intervention, become better able to understand the environmental contexts that influence others' emotions appear more likely to then respond to emotional cues in a cooperative manner (Belacchi & Farina, 2010). Additionally, research has shown that other-oriented emotions such as empathy and sympathy that require the ability to understand and interpret other's emotions in context help drive prosocial responses, which in turn are associated with being more well-liked by peers and teachers, having more supportive

social relationships, and receiving more assistance from teachers (Spinrad & Eisenberg, 2014). When children form close social bonds to individuals in their class, they are more likely to remain focused, follow directions, and demonstrate interest in classroom activities, whereas experiences with negative social interactions tend to result in decreased interest in school (Hughes & Kwok, 2007; Murray, Murray, & Waas, 2008; Roorda, Koomen, Spilt, & Oort, 2011). Children who have more positive peer relationships also express more enjoyment of going to school, which in itself has been implicated as a strong predictor of academic achievement and greater classroom participation (Boulton, Don, & Boulton, 2011; Ladd, Buhs, & Seid, 2000).

In comparing the differential impact of explicit SEL on EK and ER, it is necessary to take into account that the intervention was completed with low income children, who have been shown to adapt to their risky environments by developing more reactive and impulsive ER styles (Evans & English, 2013). Although explicit SEL programs are designed to intercede in this process, it may take longer for children to learn and consistently demonstrate new ER patterns, particularly if their home and school environments are reinforcing the practice of different, sometimes competing, response styles. On the other hand, the function of EK skills such as expression recognition and situation knowledge may be more consistent across environmental contexts, which may allow children to master these skills more quickly. It is important to note that other explicit instruction paradigms associated with growth in emotional competence skills report specific increases in EK. For instance, the *Strong Start K-2* early elementary SEL intervention taught children how to identify body, facial, and situational cues and strategies for managing difficult emotions (Merrell, Parisi, & Whitcomb, 2007). First grade children who received the *Strong Start* curriculum had greater situation knowledge at the end of the year (Whitcomb & Merrell, 2012). The Dina Dinosaur Social Skills and Problem Solving Curriculum

is a preschool-based explicit emotions training adaptation of *Incredible Years* that included emotional literacy, perspective taking, anger management, and social problem-solving (Webster-Stratton, Reid, & Stoolmiller, 2008). Trials with the Dinosaur preschool program have found growth in EK at the end of the year (Webster-Stratton et al., 2008). The Emotions Course was a preschool emotions training curriculum focusing on teaching four basic emotions (i.e., happiness, sadness, anger, and fear) through puppet vignettes, emotion expression posters, games, and storybooks (Izard, Trentacosta, King, & Mostow, 2004). An RCT of the Emotions Course program found greater EK and less frequent expression of negative emotions at the end of the year (Izard et al., 2004). These studies show definitively that EK can be improved with explicit coaching.

It is also possible that the EK measures used in this study (and others) are particularly sensitive to the effects of intervention within the limited time span of the academic year, relative to the broad teacher-rated behaviors indexing ER. That is, growth in EK may have been more easily detected than change in ER due to the use of direct child assessment of discrete skills. EK was operationalized as children's performance on emotion identification tasks, which may be more sensitive to specific changes in children's accuracy and thus offer more precise measurements of growth. In contrast, ER was operationalized as teachers' impressions of regulated behavior across time, which is a far broader domain of emotional competence than performance on the ACES or ERQ tasks. It may take more dramatic changes in behavioral tendencies to be more noticeable in pre- and post-treatment assessments.

Strengths and Limitations of the Study

To date, few studies of preschool SEL programs have parsed the effects of emotion skills coaching on different emotional competence constructs. Rather, ER and EK are often used

interchangeably to represent emotion competence, and the functions of EK are often subsumed under a broad definition of emotional self-regulation (Gross & Thompson, 2007). Several strengths of this study include the use of an explicit SEL intervention to test the malleability of emotional competence pathways to change, a randomized control design that allows for empirical analysis, and longitudinal multi-informant, multi-method assessment that includes direct child assessment, parent-report, and teacher-report. Crucially, EK and ER were separated for analyses to tease apart potential differential effects on school readiness outcomes, while the double mediation design allowed for comparison of their relative contributions to kindergarten adjustment.

One limitation of the study, however, is that due to ceiling effects on the assessment measures used, EK was no longer assessed after the prekindergarten year. The inclusion of equivalent, age-appropriate EK assessment might have allowed for the documentation of change across a longer span of time. The more truncated developmental span that was assessed may also be associated with the lack of cross-time associations between EK and ER, which may unfold over a greater period of time than measured in this study.

An additional limitation is that ER was measured through a more global teacher-rating rather than a direct laboratory assessment. Although teacher ratings have the potential to capture children's naturalistic social-emotional behavioral patterns under a variety of circumstances, there is also the likelihood of bias in that initial impressions of children's social-emotional capacities may instead become an anchor point that is resistant to change even after extended observations. Furthermore, due to the subjective nature of global behavioral ratings, there may be more drift between teachers' ratings, such that variability in ER might be more reflective of raters' differing interpretations of questionnaire items rather than true variability of ER capacity.

Another limitation is that, although the REDI intervention included explicit lessons in emotions and emotion coaching by teachers, it also included multiple components. Although we anticipate that the effects of the intervention on EK were likely due to the explicit focus, we cannot rule out the possibility that other aspects of the intervention also contributed to growth in EK.

Study participants included only children from low-income families enrolled in Head Start preschools. As such, these results may not be generalizable to preschool populations of differing socio-economic backgrounds and other types of classroom settings.

Implications

Explicit SEL frameworks are evidence-based approaches founded in theories of social-emotional development. However, as the field moves to tackle issues of replicability and more wide-spread incorporation of SEL into standard curricula, it is necessary to better understand the mechanisms of change in SEL and to identify the active ingredients responsible for academic and social-emotional outcomes. This necessitates a return to basic research into the developmental pathways of emotional competence components such as emotion knowledge and emotion regulation. By illuminating these interrelations and determining if they are associated with differential school outcomes, this study sought to test theory in a field-based experimental context and also inform recommendations to guide evidence-based intervention design. The results validate the value of focusing on boosting EK in preschool interventions for children from economically-disadvantaged families, as one strategy for enhancing their behavioral and academic adjustment after the transition into kindergarten.

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Appendix A

Table 1
Means and Standard Deviations of Predictor Variables

	Condition	Head Start- pretreatment			Head Start - posttreatment		
		<i>N</i>	<i>M</i>	<i>SD</i>	<i>N</i>	<i>M</i>	<i>SD</i>
Emotion Knowledge (ERQ)	Control	161	1.34	(.28)	157	1.52	(.26)
	Intervention	190	1.37	(.31)	176	1.61	(.24)
Emotion Knowledge (ACES)	Control	161	5.68	(2.27)	157	7.12	(2.28)
	Intervention	190	5.40	(2.17)	176	7.45	(2.36)
Emotion Regulation (teacher-rated)	Control	161	3.95	(.96)	157	4.12	(1.04)
	Intervention	190	4.13	(.93)	176	4.40	(1.04)

Table 2
Means and Standard Deviations of Kindergarten Outcomes by Condition

	Condition	Head Start-pretreatment			Kindergarten-posttreatment		
		<i>N</i>	<i>M</i>	<i>SD</i>	<i>N</i>	<i>M</i>	<i>SD</i>
Verbal ability (EOWPVT)	Control	161	84.30	(13.82)	157	87.77	(12.31)
	Intervention	190	84.88	(14.00)	176	88.96	(10.41)
Blending/phoneme decoding (TOWRE)	Control	161	11.53	(4.30)	157	1.52	(3.04)
	Intervention	190	11.58	(4.26)	176	1.95	(3.59)
Elision/sight word reading (TOWRE)	Control	161	7.71	(3.43)	157	8.15	(7.71)
	Intervention	190	8.21	(3.49)	176	7.53	(8.16)
Academic competence (APQ)	Control				157	2.95	(1.19)
	Intervention				176	2.95	(1.26)
Learning Behavior (teacher-rated)	Control	161	4.91	(.89)	157	4.56	(1.05)
	Intervention	190	4.86	(.88)	176	4.81	(1.03)
Learning Behavior (assessor-rated)	Control	161	2.58	(.48)	157	2.80	(.38)
	Intervention	190	2.49	(.61)	176	2.81	(.39)
Prosocial Behaviors (teacher-rated)	Control	161	3.94	(.94)	157	3.94	(1.04)
	Intervention	190	4.00	(.86)	176	4.23	(1.10)
Prosocial Behaviors (parent-rated)	Control	161	4.03	(.90)	157	4.07	(.92)
	Intervention	190	4.01	(.93)	176	4.15	(.88)
Aggressive Behaviors (teacher-rated)	Control	161	2.01	(.95)	157	1.96	(.83)
	Intervention	190	1.85	(.81)	176	1.74	(.85)
Aggressive Behaviors (parent-rated)	Control	161	2.93	(.94)	157	2.87	(.97)
	Intervention	190	2.88	(1.02)	176	2.68	(.96)

Table 3

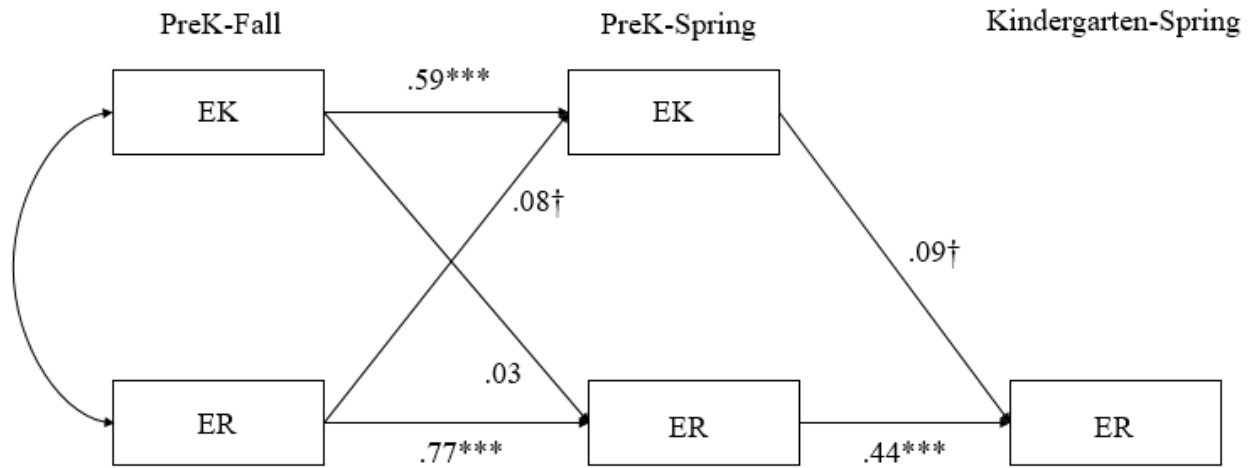
Correlations Between Emotional Competence and Kindergarten School Outcomes

Measures	1	2	3	4	5	6	7	8
PreK Fall								
1 Emotion Knowledge	--							
2 Emotion Regulation	-.001	--						
PreK Spring								
3 Emotion Knowledge	.58**	.08	--					
4 Emotion Regulation	.01	.77**	.09	--				
Kindergarten Spring								
5 Emotion Regulation	.10†	.43**	.14*	.44**	--			
6 Academic Competence	.33**	.12*	.37**	.13*	.22**	--		
7 Learning Behaviors	.30**	.23**	.33**	.21**	.51**	.49**	--	
8 Prosocial Behaviors	.19**	.30**	.28**	.31**	.65**	.36**	.56**	--
9 Aggressive Behaviors	-.21**	-.33**	-.28**	-.38**	-.66**	-.31**	-.48**	-.71**

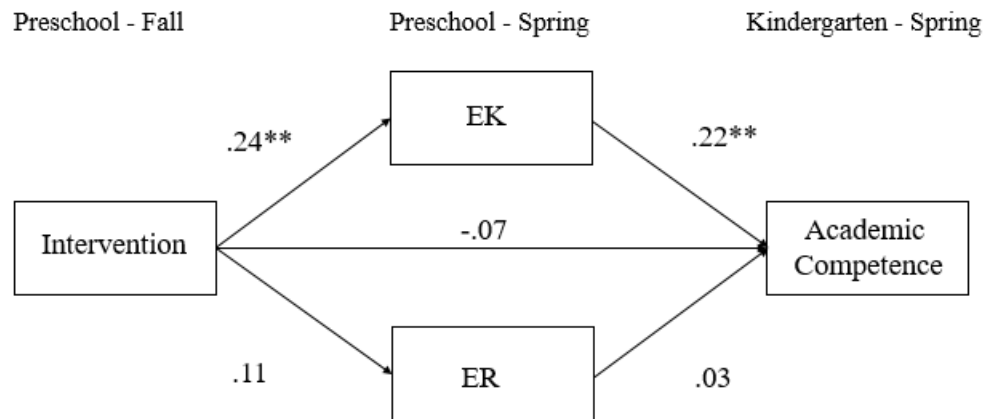
† $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .01$

Appendix B

Figure 1. Cross-Lagged Panel of Emotional Competence Variables



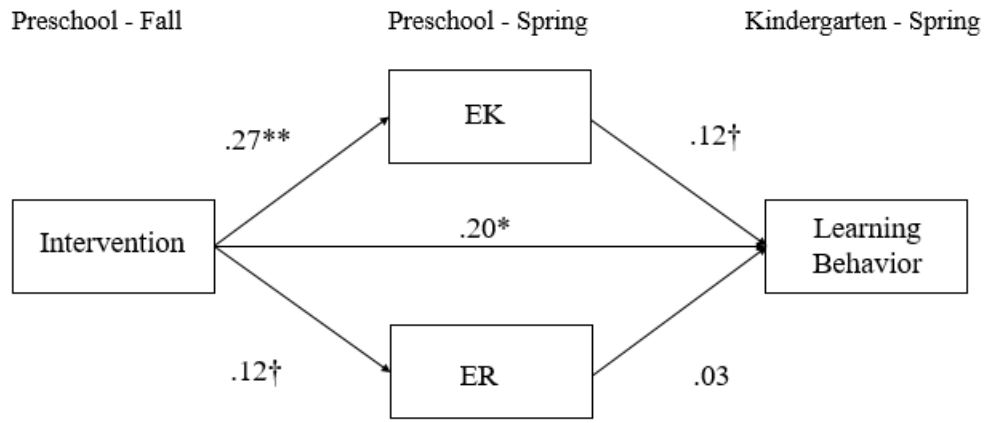
$^{\dagger}p < .10$. $^{***}p < .01$.

Figure 2. Mediated Intervention Effects on Academic Competence

** $p < .01$.

Note: Covariates include preintervention EK, ER, age, gender, verbal ability, and maternal education

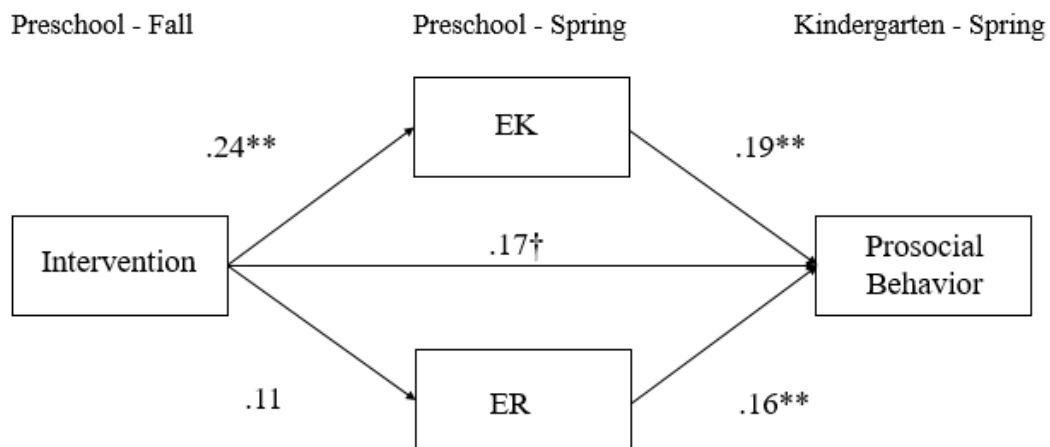
Figure 3. Mediated Intervention Effects on Learning Behavior



† $p < .10$. ** $p < .01$.

Note: Note: Covariates include preintervention EK, ER, age, gender, verbal ability, and maternal education

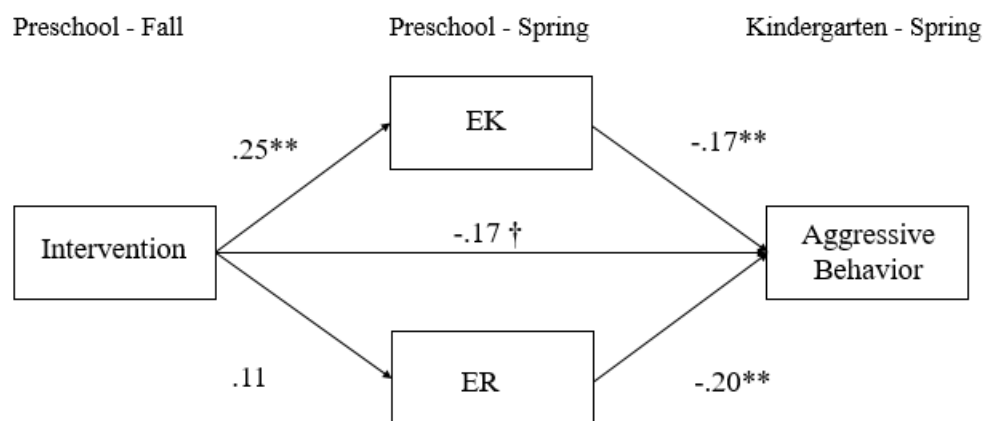
Figure 4. Mediated Intervention Effects on Prosocial Behavior



† $p < .10$. ** $p < .01$.

Note: Covariates include preintervention EK, ER, age, gender, verbal ability, and maternal education

Figure 5. Mediated Intervention Effects on Aggressive Behavior



† $p < .10$. ** $p < .01$.

Note: Covariates include preintervention EK, ER, age, gender, verbal ability, and maternal education