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Classroom Age Composition and Vocabulary Development Among At-Risk Preschoolers

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Research Findings: The purpose of this exploratory study was to examine the relationship between classroom age composition and preschoolers' vocabulary gains over an academic year and also to examine whether these relations were moderated by classroom quality. In this study ($N = 130$ children in 16 classrooms representing a subset of all children enrolled in these classrooms), results showed a significant cross-level interaction between classroom age composition and children's age, suggesting positive effects of greater variance in classroom age composition for younger but not older children. The interaction between behavior management (1 dimension of classroom quality) and classroom age composition was also significant, indicating that a wider distribution of classroom age composition was positively related to children's vocabulary gains within classrooms characterized by better behavior management. *Practice or Policy:* Findings underscore the importance of children's social interactions with more knowledgeable conversational partners in promoting their vocabulary development and signify the need to help teachers learn how to manage children's behaviors so as to provide a classroom that is optimal for child learning.

Vocabulary development is often a focus of applied developmental research addressing early childhood programming because of its central importance to children's school readiness and later academic achievement (e.g., Justice, Mashburn, Pence, & Wiggins, 2008; Wasik, Bond, & Hindman, 2006). In fact, preschool children's vocabulary skills consistently predict later achievement in reading comprehension (Hindman, Skibbe, Miller, & Zimmerman, 2010; National Institute of Child Health and Human Development Early Child Care Research Network, 2005; Storch & Whitehurst, 2002), and early delays in vocabulary development have

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been associated with later reading difficulties (Catts, Fey, Tomblin, & Zhang, 2002). Of concern to researchers, practitioners, and policymakers are those young children reared in poverty, given their well-documented early lags in vocabulary development (Hart & Risley, 1995) that typically persist as they progress from elementary to high school (Puma et al., 1997).

Not surprisingly, considerable attention has focused on ways to facilitate the early vocabulary development of preschool children from lower socioeconomic status backgrounds in order to mitigate the well-documented achievement gap in the area of vocabulary (e.g., Neuman & Celano, 2001; Tabors, 1997; Wasik et al., 2006; Weizman & Snow, 2001; Wells, 1986). For instance, recent research has focused on the role that young children's peers may play in facilitating vocabulary development (e.g., Henry & Rickman, 2007; Mashburn, Justice, Downer, & Pianta, 2009). These investigations of peer effects within preschool classrooms show that the language skills of children's classmates are a significant and unique predictor of language growth, even beyond effects attributable to instructional quality (Mashburn et al., 2009). Specifically, higher peer language skills were positively related to children's language outcomes during prekindergarten, indicating that children may benefit from being in a classroom that, in the aggregate, contains older, more cognitively advanced children and that this is particularly true for children with lower language skills. Such findings suggest that classroom age composition may be an important consideration in understanding factors that influence children's vocabulary development within early education settings, as it provides information about peer characteristics in the classroom. For instance, if children's vocabulary growth is facilitated through their interactions with peers, it may be important for younger children (e.g., 3-year-olds) to have opportunities to interact with older preschoolers, as would occur in mixed-age classrooms that serve 3-, 4-, and 5-year-olds.

Presently, there is a great deal of variability in the age composition of preschool classrooms within the United States. Some classrooms, referred to as *same-age classrooms,* enroll only children within a particular age range; these typically enroll only 3-year-olds or only 4-year-olds. Other classrooms, characterized as mixed-age classrooms, have children whose ages may span several years (Goodlad & Anderson, 1987; McClellan, 1994) and may serve in one setting children as young as 3 years and as old as 5 or 6 years (e.g., Winsler et al., 2002). Although the way in which children are grouped within classrooms is highly variable, it is unclear whether classroom age composition has impacts on children's growth, particularly in the area of vocabulary development. Therefore, the primary aim of this study was to determine the extent to which classroom age composition, operationalized based on variation in children's chronological age, is associated with children's vocabulary development over an academic year. In addressing this aim, we examined the vocabulary gains of 130 children enrolled in 16 preschool classrooms, which represented a subset of all children enrolled in these classrooms. Given that we did not have information on the ages of all children within the enrolled classrooms, the study represents an exploratory examination of the way in which classroom age composition may influence children's language growth.

CLASSROOM AGE COMPOSITION AND PRESCHOOL EDUCATION

The use of mixed-age classroom composition in the field of early childhood development has its roots in both social cognitive (Bandura, 1986; Rogers, 1987; Tierney & Rogers, 1989) and social

cultural (Vygotsky, 1930/1978) theories of learning and development. From these perspectives, interacting with older, more competent peers seems developmentally beneficial to children because it affords younger children the opportunity to engage in more challenging tasks and therefore experience greater cognitive growth than children without such opportunities. At the same time, it affords older children in such settings the opportunity to scaffold younger children, which may also provide benefits. For instance, younger children can enrich their learning by observing, emulating, and imitating the behaviors of older children (Bandura, 1986), whereas older children can practice prosocial behaviors (Derscheid, 1997; Urberg & Kaplan, 1986) and leadership skills as they serve as mentors for young children by providing support and guidance (Wertsch, 1985). In short, mixed-age classrooms provide children with the opportunity to form relations with a wider variety of children compared with their counterparts in same-age classrooms. Whaley and Kantor (1992) explicitly discussed the positive advantages of mixed infant/toddler classrooms, arguing that such classrooms provide children with a ''family'' and collaborative atmosphere. These researchers also suggested that mixed-age classrooms might help to minimize competitive pressure in terms of academic development by making parents more focused on their children's individual development, which thereby decreases the competition among peers in the classroom.

There are some arguments opposed to mixed-age classrooms that favor restricting the range of ages within preschool classrooms. For instance, in a recent study examining children's learning within mixed- and same-age classrooms, Moller, Forbes-Jones, and Hightower (2008) asserted that same-age classrooms allow teachers to target a specific age group in their curriculum, which allows them to focus on what is developmentally appropriate for that age group and thus may lead to better classroom quality. These researchers showed that preschoolers who are closer in age more closely resemble one another in terms of their skill and knowledge development. In addition, contrary to Whaley and Kantor's (1992) assertion that older children nurture younger children in mixed-age classrooms, Goldman and Chaillé (1984) found no evidence that older children engage in more nurturance or mentoring in mixed-age (3- to 5-year-old) groups compared to same-age groups. In general, it is somewhat unclear as to whether preschool-age children benefit from being in mixed- versus same-age classrooms and, if there is an advantage to either, whether this advantage extends to both older and younger children within the setting.

CLASSROOM AGE COMPOSITION AND LANGUAGE DEVELOPMENT

Although there is a lack of congruence in findings among the available research on the effects of classroom age composition on child learning, researchers have considered how classroom age composition may be associated with preschoolers' language skills indirectly by examining children's communicative interactions with peers in mixed- and same-age programs. For example, Winsler et al. (2002) compared children attending two same-age university-based classrooms (either 3-year-olds or 4-year-olds) with children attending the same university-based preschool the following year when the preschool adopted a mixed-age classroom model (3- to 4-year-olds). The researchers found that in the same-age classrooms, 4-year-olds tended to spend more time interacting with other children (as opposed to spending time alone) when given the choice compared to 3-year-olds; however, age differences in peer interaction were not found in the

mixed-age classroom. Winsler et al. also found that over the span of 22 weeks, children in the mixed-age preschool classrooms significantly decreased the amount of time they spent interacting with peers of a different age. The results of this study would seem to suggest that children may prefer to interact with their same-age peers even when placed in mixed-age classrooms.

In contrast, Derscheid (1997) examined children in mixed-age (2- to 4-year-old) university-based child care programs and found that the longer 4-year-olds spent in a mixed-age child care program, the more frequently they spoke to a 2-year-old peer with whom they were matched in forced pairings. The author concluded that mixed-age preschool settings can facilitate children's social development, which in turn increases the talk between older and younger children. One limitation of this study, however, is that this was a forced pairing rather than a naturalistic observation of classroom dynamics. It is interesting to note that the available research presents conflicted findings regarding the experiences of children in mixed- and same-age classroom settings; moreover, it is difficult to extrapolate from such work how classroom age composition might influence children's language development over time. It is possible, for instance, to speculate based on the Winsler et al. (2002) findings that variation in classroom age composition (i.e., being in a mixed- vs. same-age classroom) would have little impact on children's language growth if, in either setting, children tend to interact with same-age peers.

Studies that look specifically at children's achievement over time within mixed- and same-age classrooms provide the most direct route for understanding whether classroom age composition affects development; there are a dearth of studies of this nature, however. A recent exception is research by Moller et al. (2008) that examined 806 preschoolers representing every preschool classroom ($N = 70$) within one public school district serving primarily low-income, minority children. Classrooms were not differentiated in terms of same age or mixed age, although the average age span within classrooms in this sample was 18 months. These researchers sought to determine whether variation among classrooms in terms of children's age was associated with achievement over an academic year. The measure of achievement utilized was the Child Observation Record, which includes three factors: Cognitive Skills, Social Engagement, and Coordinated Movement/Motor Skills. Although this is an indirect assessment, this tool has been validated against the Peabody Picture Vocabulary Test (PPVT), a direct assessment of children's receptive vocabulary (Fantuzzo, Coolahan, Mendez, McDermott, & Sutton-Smith, 1998). What is interesting is that Moller et al. reported that when they controlled for children's age and gender, a wider range (and standard deviation [*SD*]) in preschool children's ages within preschool classrooms was negatively related to children's scores over time on the Child Observation Record. The authors therefore contended that mixed-age preschool classrooms may not benefit children's development, particularly in the area of language development; however, a limitation of this study is that children's language skills were not directly examined. Bell, Greenfield, and Bulotsky-Shearer (2013) replicated and enhanced the methodological approach used by Moller et al. They found that classroom age composition was not associated with low-income preschool children's growth in multiple domains of school readiness, including language and literacy, early math, social and emotional skills, and approaches to learning. Similar to Moller et al., this research also used an indirect measure, with children's skills rated by their teachers. In fact, teacher ratings of children may be affected by the variability of the children within the classroom and teachers' characteristics and perspectives (Mashburn, Hamre, Downer, & Pianta, 2006). Consequently, an important impetus for the present study was to determine whether the findings of Moller et al. and Bell et al., particularly those with respect to language

development, would be replicated using a well-validated, direct measure of vocabulary skill, given that few studies have directly examined how classroom age composition relates to language development specifically.

Some researchers have extended these conflicting findings and reported that the effect of mixed-age groups may differentially affect younger versus older children. Specifically, mixed-age groups may benefit younger children yet have no effect or even a negative effect on older children (e.g., Bailey, Burchinal, & McWilliam, 1993; Dunn, Kontos, & Potter, 1996; Winsler et al., 2002). To this point, Justice, Petscher, Schatschneider, and Mashburn (2011) recently emphasized the importance of considering a child's reference status—that is, his or her skills in relation to those of his or her classmates—in understanding how classroom composition may be influential to children's growth in language skills. This is because children's ability level, particularly in language, may serve to mediate their experiences with peers in their classrooms and, in turn, the benefits (or lack thereof) they may receive from being in mixed- or same-age classroom settings.

THE MODERATING ROLE OF CLASSROOM QUALITY

Considering the previously addressed mixed results regarding the way in which classroom age composition may promote young children's development, it is important to examine other factors that may moderate these relations and may partially account for some of the incongruent findings in the literature. For example, Bell et al. (2013) suggested that it would be important to include more classroom factors (e.g., social environment, structure of the classroom) in analyses to better understand the role of classroom age composition. In particular, classroom quality (i.e., dynamics of teacher–child interactions) is an important factor that may moderate the relationship between classroom age composition and preschoolers' language development. Wilkinson and Fung (2002) also suggested that to properly evaluate the compositional effects of classrooms and their impacts on children's learning, it is necessary to examine the group or class composition in relation to classroom quality and children's learning outcomes.

Classroom quality refers to how teachers interact with students on a daily basis and includes three broad domains: emotional support, instructional support, and classroom organization (e.g., Pianta & Hamre, 2009; Pianta, La Paro, & Hamre, 2008). Emotional support describes teachers' abilities to support children's social and emotional functioning; however, instructional support encompasses teachers' use of classroom activities to support children's cognitive and language skills (Pianta et al., 2008). Classroom organization describes how teachers effectively organize and manage children's behavior, time, and attention in the classroom (Emmer & Stough, 2001; Pianta et al., 2008). Within each of these three major domains is a set of more specific dimensions of classroom interactions that likely contribute to children's academic and social outcomes (Pianta & Hamre, 2009; Pianta et al., 2008). For example, emotional support consists of four dimensions—positive climate, negative climate, teacher sensitivity, and regard for student perspectives.

Although all of the specific dimensions of classroom quality are presumed to be important to children's development, few studies seek to articulate the specific dimensions that may influence the relations between classroom composition and children's outcomes. To our knowledge, only one recent study (Mashburn et al., 2009) examined whether the effects of peers' skills on

preschoolers' language growth may be moderated by the quality of social interactions within classrooms including positive climate, negative climate, teacher sensitivity, overcontrol, and behavior management. Results showed that only behavior management emerged as a significant moderator of classroom composition effects on children's language outcomes; the other dimensions (e.g., positive climate, teacher sensitivity) were not significant moderators (Mashburn et al., 2009). This finding suggests that although dimensions of classroom quality such as teacher sensitivity are positively related to children's academic growth (Pianta & Hamre, 2009; Pianta et al., 2008), they may not facilitate peer interactions in the classrooms and thus do not impact the associations between classroom age composition and children's language learning. Instead, a well-managed classroom may provide a supportive context for peer interaction and children's language learning to occur. Specifically, within well-managed classrooms, teachers may communicate behavioral expectations to children, monitor the classroom effectively to prevent problems before they occur, and use effective strategies to redirect misbehaviors; thus, there are few oppositional behaviors (Pianta et al., 2008). Consequently, instructional time may be maximized so that children have more opportunities to talk with teachers and children, which facilitates their language learning. Moreover, one recent study reported that preschool teachers' behavior management significantly predicted preschool children's early language and literacy skills (Dobbs-Oates, Kaderavek, Guo, & Justice, 2011). Collectively, these findings indicate that effective behavior management may promote peer interactions and also be related to children's language learning. It is logical to hypothesize that the same degree of age mixing may manifest itself differently based on the level of teachers' behavior management. Based on these findings, the present study examined the moderating role of classroom quality on the relation between classroom age composition and children's language skills with a specific focus on one dimension of classroom quality—behavior management.

THE PRESENT STUDY

Given the inconsistent research findings regarding the association between classroom age composition and child development, the purpose of the present study was to further examine the association between classroom age composition and child outcome, with a particular focus on vocabulary development. Our study extends prior research by adopting the approach used by Moller et al. (2008) as well as Bell et al. (2013) and using the range and *SD* of children's age to capture the variability of classroom age composition. As a result, we (a) examined children's vocabulary gains at two different levels (i.e., the child level and classroom level) and partitioned separate variance at each level while controlling for variance across these two levels; (b) assessed vocabulary skills through the use of a well-validated, direct measure; and (c) examined the moderating role of behavior management in explaining the relations between classroom age composition and child outcome. Two specific research questions were addressed:

1. To what extent is classroom age composition related to preschoolers' vocabulary gains over an academic year?
2. To what extent are the relations between classroom age composition and preschoolers' vocabulary gains moderated by behavior management?

METHOD

Participants

The participants were drawn from a larger study evaluating preschool language curriculum (see Preschool Curriculum Evaluation Research Consortium, 2008). The larger study involved two sequential cohorts of teachers. Cohort 1 teachers participated in an experimental study investigating the outcomes of a language-focused curriculum implementation, which featured random assignment of teachers to conditions. Cohort 2 teachers participated in a correlational study investigating generally the associations among classroom characteristics and children's language outcomes; all teachers implemented a language-focused curriculum. The present study, which investigated relations between classroom age composition and children's outcomes, was based on the Cohort 2 implementation and thus involved only those teachers and children involved in the second cohort of data collection, in which all teachers received materials to implement a language-focused curriculum. Thus, all teachers in the present study were implementing the same instructional program.

In total, participants included 16 teachers and 130 preschool children. Ten children per classroom were enrolled in the larger longitudinal study, randomly selected from among the 16 children enrolled in each classroom (there was no variability in classroom size due to state regulations at this time). As some children did not have data regarding their age, these children were excluded. As a result, data from 7 to 10 children per classroom (130 in total) were analyzed for the present study. Therefore, the sample of 130 children represents about 44% to 63% of the enrollment within each classroom, which is characteristic of many large-scale studies of child development in early education settings (Cabell et al., 2011; Justice, Kaderavek, Fan, Sofka, & Hunt, 2009). However, it is necessary to acknowledge that the present work makes inferences regarding the relations between classroom age composition and children's language growth. Enrolled children represented a subset of the classroom population, and the data set included age information for only a portion of the classroom, which may make the measure of classroom age composition less optimal than more precise assessments used in studies that include age information for all children in the classroom. Therefore, the findings of this work should be considered exploratory.

The children were enrolled in preschool programs serving primarily at-risk children (e.g., Head Start and state prekindergarten), with participation prioritized for children residing in low-income households based on federal poverty guidelines. Classrooms were affiliated with Head Start ($n = 8$) and state-funded prekindergarten/Title I ($n = 8$). Descriptive data for the sample are presented in Table 1. Approximately 30% of children had annual family incomes of less than $25,000, 43% had incomes between $25,000 and $50,000, and 24% had incomes of more than $50,000. Approximately 55% of the children were male, and 45% were female. The majority of children were White (72%), 21% were African American/Black, 4% were Hispanic/Spanish/Latino, 1% were Native American, 1% were multiracial, and 1% were Asian. At the beginning of the school year, children's average age was 4 years, 6 months ($SD = 3.7$ months; range = 3 years, 4 months, to 5 years, 7 months). All of the teachers were female, and 94% were non-Hispanic White ($n = 15$). Teachers' highest level of education varied: 25% had a master's degree ($n = 4$), 50% had a bachelor's degree ($n = 8$), 12.5% had an associate's

TABLE 1
Descriptive Characteristics of Child Participants

Variable	*M*	*SD*	*Range*
Child-level variables			
Age (in months)	53.76	3.70	40–68
Family income	$38,062	$29,555	$900–$251,000
Classroom-level variables			
Classroom age range (in months)	10.31	3.48	4–20
Classroom age *SD*	3.60	0.98	1.42–6.10
Behavior management (CLASS)	5.67	0.81	4.00–6.50

Note. CLASS = Classroom Assessment Scoring System–Pre-K.

degree ($n = 2$), and 12.5% had some college but no degree ($n = 2$). On average, teachers had 14 years of total teaching experience ($SD = 9.41$, range = 1–31).

Procedures and Measures

Children participated in a series of activities over the entire academic year to achieve the purposes of the larger study. Here we discuss those procedures directly relevant to the present study. In the fall (Time 1) and spring (Time 2) of the academic year, children were individually tested by trained research assistants to measure their vocabulary skill. Also, in the fall and spring of the academic year, a systematic observation was conducted within each classroom to assess classroom quality. We discuss these measures in turn.

Child vocabulary measure. The PPVT-III (Dunn & Dunn, 1997) was used to assess children's single-word receptive vocabulary; scores on this measure are strongly associated with children's more global language skills (Dunn & Dunn, 1997). This measure requires participants to select out of four options the picture that best depicts a verbal stimulus given by the examiner. Dunn and Dunn (1997) reported internal consistency reliability of .93 in a sample whose age ranged from 2 to 6 years. For all analyses, raw scores on the PPVT were used.

Behavior management. Classroom behavior management was measured using the behavior management dimension of Classroom Assessment Scoring System–Pre-K (CLASS; Pianta et al., 2008), an observational instrument that assesses the interactions between teachers and students within classrooms to characterize the quality of interactions in classroom settings. The CLASS comprises a total of 10 dimensions designed to measure three global domains of quality: instructional support (scales of concept development, quality of feedback, language modeling), emotional support (scales of positive/negative climate, teacher sensitivity, regard for student perspectives), and classroom organization (scales of behavior management, instructional learning format, productivity). For each dimension, trained and reliable observers assign a single score from 1 to 7 to the classroom, spanning a continuum of quality that encompasses low (1, 2 points), medium (3, 4, 5 points), and high (6, 7 points) levels of quality. For the present purposes, we used the scores of the behavior management dimension. A high behavior management rating (6, 7 points) reflects a classroom in which rules and expectations for behaviors are

clearly stated, few or no problematic behaviors occur, and teachers effectively monitor the classroom (e.g., redirect the misbehavior). A mid-level rating (3, 4, 5 points) on the behavior management dimension reflects a classroom in which ''rules and expectations for behaviors may be stated clearly but are inconsistently enforced,'' teachers sometimes monitor the behaviors but at other times ignore them, and ''there are periodic episodes of misbehavior'' (p. 44). A low-level rating (1, 2 points) reflects a classroom in which ''rules and expectations are absent, unclear or inconsistently enforced,'' monitoring is absent or ineffective and behaviors are not addressed, and ''there are frequent instances of misbehavior'' (p. 44).

In the present study, the CLASS was scored in both the fall and spring of the year from videotapes collected during an approximately 2-hr standardized classroom observation. The videotaped classroom observation captured three types of activities in the preschool classrooms: whole-group instruction (likely circle time), whole-group book reading, and center time. Scoring from videotapes was conducted in a lab-based setting by research assistants who had completed CLASS standard training at the University of Virginia (the CLASS development site) to a reliability criterion established by the tool's authors (see Pianta et al., 2008). Specifically, all CLASS coders exhibited interrater reliability (within 1 point) against three master-coded videos at the level of 80% agreement. Subsequent to achieving reliability in implementation, field tests were not conducted, although drift sessions were held among all reliable coders at regular intervals to ensure maintenance of reliable implementation of the scoring system. Behavior management scores across the two observation points (fall, spring) were averaged.

Classroom age composition. The chronological age of the children within a classroom was used to identify (a) the absolute range in chronological age between the youngest and oldest children enrolled in the larger study in the classroom and (b) the *SD* of the average chronological age within a given classroom. Each child's age was derived from parental questionnaires in which parents were required to provide the child's birth dates and was calculated at the beginning of the school year.

RESULTS

Analytic Strategy

Hierarchical linear modeling (HLM) was used in the current analyses to account for the nested nature of the data. Two-level models nested children within classrooms to predict their residualized gains (i.e., Time 2 scores with Time 1 score as covariates) from the classroom-level measures of classroom age composition. We used residualized gains in the models as opposed to gain scores (i.e., the change between Time 1 and Time 2 scores) because many scholars suggest that gain scores are an unreliable measure of growth (e.g., Cohen & Cohen, 1983; Linn & Slinde, 1977; Zumbo, 1999). Specifically, gain scores give an advantage to children who have high scores at Time 1 and thus are a biased measure of change (Linn & Slinde, 1977). Furthermore, the reliability of gain scores would decrease to zero when the correlation between Time 1 and Time 2 scores is large and positive (Zumbo, 1999). As Time 1 vocabulary scores were positively correlated with Time 2 scores ($r = .78$, $p < .01$) in our study, the reliability of gain scores would have been very low. When examining the residualized gains, we used PPVT raw scores as

is often recommended in HLM analysis; this is because raw scores provide an indicator of how much gain occurred over time (Bonate, 2000; Hartman, Stage, & Webster-Stratton, 2003).

Models were built in the following steps. First, the unconditional model was tested without any predictor variables to compute the intraclass correlation coefficients. The unconditional model predicting vocabulary scores yielded an intraclass correlation coefficient of .04, indicating that about 96% of the variance in spring vocabulary scores resided systematically between children in the same classroom and about 4% of the variance resided systematically between classrooms.

Second, we examined several parsimonious models for the purpose of saving degrees of freedom in the final model (Raudenbush & Bryk, 2002). Given the high correlation between classroom age range and classroom age *SD,* we included both variables hierarchically within a single model and found that the reduction in variance was less than 0.1% when classroom age *SD* was added to the model that initially contained classroom age range. These results indicated that there was almost no unshared variance between range and *SD* for the classroom age composition variable. Thus, classroom age *SD* was utilized in all analyses, and classroom age range was trimmed because of redundancy.

As there may have been possible child and teacher predictors associated with children's vocabulary achievement, we tested each predictor in the model separately. The predictors reaching statistical significance ($p < .05$) stayed in the model as covariate variables. As a predictor of children's vocabulary, Time 1 scores were entered at Level 1. Other child factors (gender, maternal educational achievement: bachelor's degree or not, family income) were entered, and only gender and family income were significant with Time 1 scores in the model. Teacher/classroom factors (teacher educational attainment: bachelor's degree or not, years of teaching experience, Head Start program or not) were entered but were never significant as predictors of children's vocabulary gains.

Third, based on the results using these models, a final model was created that included children's Time 1 scores, children's gender, and children's family income at Level 1 and classroom age *SD* and behavior management at Level 2. All continuous predictors were centered at their grand means. The analysis for the set of models was conducted in three stages. In the first stage, we tested the main effect of classroom age *SD* on children's Time 2 vocabulary scores, controlling for children's Time 1 scores, gender, and family income. In the second stage, the cross-level interaction between classroom age *SD* at Level 2 and child age at Level 1 was tested in the model. In the third stage, two-way interactions, namely Behavior Management × Classroom Age Composition, were tested.

Descriptive Statistics

We examined the main study variables descriptively. Table 1 presents the means, ranges, and *SD*s for children's characteristics and classroom-level variables. As can be seen in Table 1, the mean of classroom age range was 10.31 months (range = 4–20 months, $SD = 3.48$). The mean of classroom age *SD* was 3.6 months (range = 1.42–6.1 months, $SD = 0.98$). Thus, there was variability across classrooms in terms of classroom age composition. The correlation between classroom age range and age *SD* was high ($r = .95$, $p < .01$). The mean of the averaged behavior management scores was 5.67 ($SD = 0.81$), reflecting a moderate level of behavior

management. The difference between the mean spring score ($M = 5.92$) and the mean fall score ($M = 5.47$) was significant ($p < .01$), indicating that the level of teachers' behavior management increased over the academic year. The fall scores for behavior management were not significantly correlated with the spring scores.

The means, ranges, and *SD*s for children's vocabulary raw and gain scores by each age group are presented in Table 2. As shown, for the full sample, the mean of fall raw scores was 55.12 ($SD = 14.09$), the mean of spring raw scores was 68.94 ($SD = 15.68$), and the mean of gain scores was 13.82 ($SD = 10.24$). Vocabulary gains were greatest for 3-year-olds ($M = 16.29$, $SD = 10.53$) among three groups. Four-year-olds made more gains in vocabulary ($M = 13.04$, $SD = 10.23$) than 5-year-olds did ($M = 11.21$, $SD = 9.24$). These data suggest that vocabulary growth was greater overall for younger children versus older ones.

Classroom Age Composition and Children's Vocabulary Gains

To address the first research question, we examined the relations between classroom age *SD* and children's gains in vocabulary skill. Table 3 reports findings from the set of HLM models. As shown, the main effect of classroom age *SD* on children's vocabulary gains was not significant ($\beta = -0.86$, $p = .65$). The variable of child age was a significant predictor ($\beta = -0.62$, $p < .01$). In addition to assessing main effects of the classroom composition variables on children's vocabulary gains, we also examined possible cross-level interactions between the classroom age composition variable and children's age (also see Table 3). We sought to determine whether the relation between classroom age composition and vocabulary gains might be dependent upon children's age, as has been suggested in some prior reports. The cross-level interactions between classroom age *SD* and children's age in the fall were significant ($\beta = -1.22$, $p < .01$; see Table 3). As depicted in Figure 1, for younger children, being in classrooms with a wider range in age appeared to yield higher gains in vocabulary during the academic year, whereas older children did not exhibit any vocabulary gain when enrolled in classrooms with a wider distribution of ages. The effect size for Classroom Age *SD* × Children's Age was 0.12, indicating that the magnitude of this cross-level interaction effect was small.

The Moderating Role of Behavior Management

An additional goal of the present study was to examine whether the association between classroom age composition and children's vocabulary gains was moderated by behavior management,

TABLE 2
Descriptive Statistics for Child Vocabulary

	Fall vocabulary (raw scores)			*Spring vocabulary (raw scores)*			*Vocabulary gains*		
Group	*M*	*SD*	*Range*	*M*	*SD*	*Range*	*M*	*SD*	*Range*
Full sample ($N = 130$)	55.12	14.09	24–94	68.94	15.68	2–110	13.82	10.24	–20 to 38
3-year-olds ($n = 51$)	41.35	6.39	24–50	57.61	12.89	20–82	16.29	10.53	−13 to 38
4-year-olds ($n = 45$)	56.98	3.63	51–64	70.02	10.30	41–95	13.04	10.23	−20 to 38
5-year-olds ($n = 34$)	73.29	7.69	59–94	84.50	10.88	61–110	11.21	9.24	−8 to 33

TABLE 3
Fixed Effects for Classroom Age Standard Deviation as a Predictor of Vocabulary Gain

	Spring vocabulary (PPVT)		
Parameter	*Coefficient*	*SE*	*p*
Model 1: Main effects			
Child-level variables			
Fall vocabulary (PPVT)	0.81	0.06	<.01
Age	0.62	0.23	<.01
Gender	–2.95	1.71	.09
Family income	0.01	0.02	.56
Classroom-level variables			
Classroom age *SD*	–0.86	1.83	.65
Behavior management (CLASS)	0.09	0.80	.92
Model 2: Interactions			
Classroom Age *SD* × Child Age	–1.22	0.35	<.01
Classroom Age *SD* × Behavior Management	12.24	2.16	<.01

Note. PPVT = Peabody Picture Vocabulary Test; CLASS = Classroom Assessment Scoring System–Pre-K.

a specific dimension of the CLASS measure. Results showed that the interaction between behavior management and classroom age composition was significant for children's vocabulary ($\beta = 12.24$, $p < .01$; Table 3). Figure 2 depicts the moderating effect of classroom behavior management on the relationship between classroom age composition and children's vocabulary gains. This finding suggests that a higher level of variability in classroom age composition

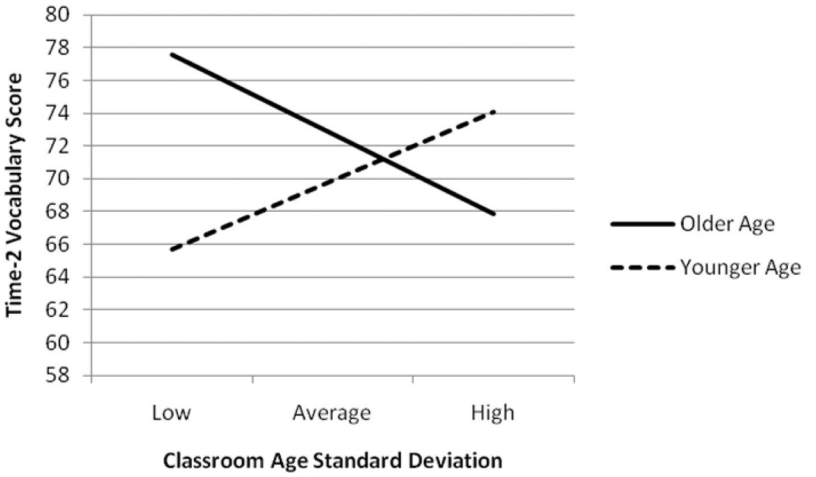

FIGURE 1 Classroom Age *SD* × Child Age interaction on fitted spring vocabulary scores, adjusting for fall vocabulary, gender, and family income. Older children = +1 *SD*, younger children = −1 *SD*. Classroom age *SD* falls at the 25th (low), 50th (average), and 75th (high) percentiles. Time 2 = Spring.

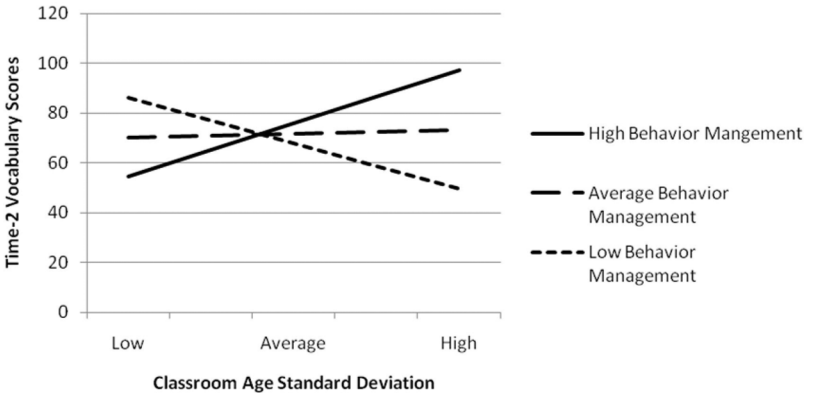

FIGURE 2 Classroom Age *SD* × Behavior Management interaction on fitted spring vocabulary scores, adjusting for fall vocabulary score, gender, and family income. Low behavior management = −1 *SD*, high behavior management = +1 *SD*. Classroom age *SD* falls at the 25th (low), 50th (average), and 75th (high) percentiles. Time 2 = Spring.

was positively related to children's vocabulary gains in high- and average-quality classroom behavior management. The effect size of Classroom Age Composition × Behavior Management was 1.42, suggesting that the magnitude of this moderating effect on child outcome was quite large.

DISCUSSION

The purpose of this study was to examine the relationship between classroom age composition and preschoolers' vocabulary gains and to evaluate whether the relationship between classroom age composition and vocabulary gains might be moderated by classroom quality in a sample of 130 preschool children in 16 classrooms. Study results did not find a significant main effect of classroom age composition on children's vocabulary gains. However, there were several significant interactions involving the classroom age composition variables. First, after we adjusted for children's gender, family income, age, and initial vocabulary skills at entry to prekindergarten, the association between classroom age composition and children's gains was positive and stronger for younger children relative to older children. Second, classroom quality—specifically behavior management—emerged as an important moderating variable, affecting the relations between classroom age composition and children's vocabulary gains. Given that the measure of classroom age composition used in this study was not optimal, these exploratory findings should be interpreted as preliminary and exploratory, thus limiting their significance for educational practice. We discuss each of these findings more thoroughly in turn.

The first major finding of the present work is that the effects of classroom age composition were dependent on children's age. Specifically, younger children were perhaps positively influenced by a wider distribution of classroom chronological ages. By contrast, older children did not show any language gain when enrolled in classrooms with a greater range in chronological age versus a lesser range. This finding is consistent with previous research examining the influence of classroom age composition in classrooms serving low-income children (Bell et al.,

2013). suggesting that for younger children, classroom composition appears to be an important consideration in anticipating vocabulary growth over an academic year (Justice et al., 2011; Mashburn et al., 2009). Moreover, we found that vocabulary gains were greater for younger children than older children, consistent with a prior study showing that Head Start children's cognitive growth (including a vocabulary measure) was greater in 3-year-olds than 4-year-olds (Puma, Bell, Cook, Heid, & Lopez, 2005). We speculate that the classroom with a wider distribution of children's ages provided benefits to younger children as a result of the greater gains that they made.

This finding has both relevance to theories of children's learning within early education settings as well as practical implications concerning classroom age composition in the preschool setting. Concerning the former, the significant interaction between child age and classroom age composition supports the theoretical assumption that interaction with more able peers results in optimal learning for younger children (Vygotsky, 1930/1978). One might presume that in day-to-day interactions with more capable peers, the language development of younger children is scaffolded by the peers with whom they are interacting. Within classrooms in which children are relatively heterogeneous in age, such opportunities are readily available given that children in preschool classrooms spend a significant portion of their day interacting with peers during free-play activities (Early et al., 2010). However, within classrooms in which children are relatively homogenous in terms of age, such opportunities may not be available. In short, the positive effects of the classroom with a wider distribution of children's ages on younger children's vocabulary development provides support to social-interactionist theories of language development, which highlight the importance of children's social interactions with more knowledgeable conversational partners in promoting language skills (e.g., Bruner, 1983; Justice & Ezell, 1999).

Concerning the practical implications of these findings, we might suggest that preschool classrooms should provide more opportunities for children to interact with more advanced peers, which may positively influence their vocabulary skills. For these children in particular, namely those youngsters, the present results also raise real questions about the benefits of homogenous groupings of pupils within classroom settings: Younger children who were in classrooms characterized by a high range in age exhibited significantly larger vocabulary growth compared to younger children in classrooms with a narrow range. Although these findings cannot be interpreted causally, they do point to the need for preschool programs to carefully consider their grouping practices and ensure that younger children have the opportunity to interact with and learn from more capable peers. In addition, preschool programs may need to pay particular attention to the experiences of more capable children in the mixed-age group, given the lack of vocabulary gains for older children. For example, teachers may allocate additional time to working more intensively on specific language skills with more advanced children.

A second finding of this work, and one that extends the available research on classroom age composition within preschool settings, is that classroom quality significantly moderated the relations between classroom age (*SD*) composition and children's gains in vocabulary. The current study found that a wider distribution of age was positively related to children's vocabulary gains when classrooms provided high-quality behavior management. It is important to note that classrooms with more homogeneous age groups score lower on vocabulary skills when the quality of behavior management is high, which is slightly contrary to our first finding indicating that the benefits to younger children become more pronounced as the classroom age range increases. Our

data did not allow us to explain this dynamic mechanism at play, so future research should examine how the three-way interactions among child age, classroom age composition, and behavior management predict children's language skills. Despite the unexpected inconsistency, these findings are particularly important, suggesting that high-quality teaching (behavior management), when applied within classrooms with a wider range of children's ages, may offer special benefit to children's vocabulary growth.

High-quality behavior management was operationally defined in the present study as one in which teachers provide clear and consistent behavior expectations, monitor behavior, and use effective strategies to prevent and redirect misbehaviors (CLASS; Pianta et al., 2008). In fact, preschool teachers' behavior management is a key teaching skill and has been linked to child behavior and literacy learning, such that positive behavior management strategies were related to less child severe misbehavior (Kim, Stormont, & Espinosa, 2009) and more gains in children's language and literacy skills (Dobbs-Oates et al., 2011). Recent work by Mashburn et al. (2009) has suggested that well-managed classrooms moderate the association between peer language skills and preschoolers' expressive language skills; within well-managed classrooms, children's language learning may be well organized to ensure an optimal amount of time in classroom instruction. Our findings further support these previous studies and underscore the importance of behavior management in the context of classrooms with a wider range of children's ages.

These findings may have important practical implications for researchers, educators, and policymakers. Before discussing these we must emphasize that this study focused exclusively on children's vocabulary development and did not address other key areas of development. Thus, the findings must be interpreted in this vein, and replication with other domains of development should be pursued. In addition, as described previously, the subsample (7–10 among 16 children enrolled in each classroom) selected for this study may not have accurately represented the age mix of classrooms, thus limiting the significance for practical implications in regard to the mixed-age classrooms. Nonetheless, we do offer fresh insight into questions concerning how to make the mixed-age classroom a supportive context as suggested by this exploratory work. It may be difficult for older children in particular to reap the benefits of mixed-age classrooms because of the challenges their teachers face within such contexts, such as ''lack of time for teaching the required content, a greater workload, and lack of time for individual attention and remediation'' (Veenman, 1995, p. 324). Some experts have proposed that effective classroom instruction within mixed-age classrooms may need to look different from traditional conceptualizations of instruction for same-age classrooms, and our findings suggest that this proposal may have merit. As Hattie (2002) suggested, teachers likely need to use differential teaching methods when they switch from mixed-age classrooms to restricted-age classrooms (or vice versa). Thus, we suggest that providing teachers with professional development targeted specifically at how to teach in mixed-age classrooms might be one way to increase the positive benefits of mixed-age classrooms on children's vocabulary development. Through professional development, teachers may learn how to couple high-quality teaching with curriculum differentiations suited to mixed-age teaching. Such professional development can also help teachers to cope with the challenges that may occur in leading mixed-age classrooms, which may promote teachers' sense of self-efficacy in working with children who may vary substantially in age. Of particular import, from our perspective, is helping teachers learn how to manage children's behaviors so as to provide a classroom that is optimal for child learning.

Limitations and Future Studies

In conclusion, the present research explored the relations among classroom age composition, classroom quality, and children's vocabulary development over an academic year. Findings suggest that classroom age composition may be associated with children's vocabulary development. This work underscores the importance of future research that pursues more rigorously the possible consequences of classroom age composition on preschoolers' learning and educators' teaching within early childhood. This is important because of the limitations of the present work.

First, the results of the current study are correlational. Thus, we cannot assume that the relationship observed between classroom age composition and children's vocabulary development is causal in nature. Experimental and longitudinal research is needed to determine whether mixed-age classrooms have definitive effects on preschool children's gains in vocabulary. Second, data from only 7 to 10 children were collected within each of the classrooms enrolled in the present study. As a result, the subsample selected for the study may not have accurately reflected the population of children enrolled in each classroom. Thus, the findings obtained from this exploratory study need to be interpreted with caution. Clearly, a more reliable estimate of classroom age composition would need to include all children in the classroom. Future studies should replicate these findings using a more precise measure of classroom age composition. Third, this study examined the complex relationship between classroom composition and children's vocabulary growth (measuring change between two time points). However, the change between two time points cannot fully represent an individual child's academic growth over time. As Moller et al. (2008) proposed, one future direction could be to examine the effects of classroom composition on children's development across multiple time points (at least three time points). The use of multiple time points would permit exploration into the possibility of both linear and nonlinear academic trajectories. Fourth, because of the limited sample size of this study (130 children in 16 classrooms), we examined how one dimension of classroom quality, namely behavior management, moderated the relations between classroom age composition and children's vocabulary outcomes. Given that classroom quality is complex and multifaceted, future work should use a larger sample size to examine the other dimensions of classroom quality in combination with classroom age composition that may contribute to child learning. Finally, the present study only included children in publicly funded preschool classrooms serving at-risk children. Thus, it is not clear whether these findings can be generalized to other settings, such as programs serving children from different demographic backgrounds or children with special needs. Research efforts designed to study the effects of classroom age composition on a more general population of children is an important future line of inquiry.

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