



## Frequency of instructional practices in rural prekindergarten classrooms and associations with child language and literacy skills

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### ABSTRACT

Although publicly-funded prekindergarten (pre-k) programs have been designed to promote children's school readiness, programs have tended to support early literacy skills to a greater degree than early language skills. Given the importance of both language and literacy skills for children's reading acquisition and academic achievement, the present study sought to understand whether different pre-k classroom instructional practices were related to gains in language and/or literacy skills. Teacher-child language exchanges, children's engagement in domain-specific learning activities, and the use of different types of activity settings were examined in 63 pre-k classrooms for 455 children living in six rural counties in the Southeastern United States. Hierarchical linear models showed that gains in expressive language were positively associated with teacher-child language exchanges and negatively associated with large-group activities. Gains in phonemic awareness and initial-sound knowledge were positively related to sound-focused activities and small-group settings. Gains in reading decoding skills were also positively associated with small-group settings. Implications for research, teacher practice, and professional development are discussed.

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Children's school readiness skills have been shown to predict academic achievement during elementary school and beyond (Duncan et al., 2007; Early et al., 2010; Quirk, Grimm, Furlong, Nylund-Gibson, & Swami, 2016; Sabol & Pianta, 2017), making the identification of educational practices that promote children's skills prior to kindergarten a priority. Accordingly, both state and federal governments in the United States have invested heavily in preschool and/or prekindergarten (pre-k) programs to promote school readiness skills, especially among children from economically disadvantaged families (Early et al., 2010; Phillips et al., 2017; Weiland, 2016). Evaluations of federally-funded Head Start and state-funded pre-k programs indicate that, on average, they are successful in promoting academic skills such as decoding skills, but are less successful in promoting language skills (Peisner-Feinberg, Mokrova, & Anderson, 2017; Phillips et al., 2017; Puma et al., 2012). Yet, language skills are necessary for school success, particularly when instruction moves beyond acquisition of rote skills, such as

the transition in reading from learning decoding skills to gaining comprehension skills (Lonigan, 2015). The goal of this study was to examine classroom instructional practices in publicly-funded state pre-k programs to identify which practices appeared to promote early literacy skills and which practices appeared to promote language skills. Further, we explored these relationships for pre-k programs in rural areas, where educational disparities exist in comparison to other geographic locations (Clarke, Koziol, & Sheridan, 2017; Miller & Votruba-Drzal, 2013; North Carolina Rural Health Leadership Alliance, 2017).

### 1. Early language and literacy skills

Literacy and language skills are important for reading success and educational attainment (Foorman et al., 2016). Early literacy skills (e.g., phonological and phonemic awareness, print structures, decoding) provide the needed tools for decoding text and are related to subsequent reading comprehension (Al Otaiba, Allor, Werfel, & Clemens, 2016; García and Cain, 2014; Justice, Mashburn, Hamre, & Pianta, 2008) and thus are an important focus of many pre-k programs. However, without adequate oral language skills, children will likely face later challenges with reading comprehension (Catts, Herrera, Nielsen, & Bridges, 2015; Foorman, Herrera,

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Petscher, Mitchell, Truckenmiller, 2015; NICHD Early Child Care Research Network, 2005; Sénéchal & LeFevre, 2002). For example, oral language skills were more predictive of reading comprehension during later grades, such as third grade (Language and Reading Research Consortium, 2017), when children need to have more automatic word-reading skills in order to read for understanding across content areas (Petscher, Justice, & Hogan, 2017). Justice, Mashburn, and Petscher (2013) found that fifth graders with poor reading comprehension had scored lowest on language assessments during early childhood as compared to fifth graders who were poor decoders or typical readers. Therefore, antecedents to reading comprehension, such as oral language skills, start early in life, and pre-k programs ideally would target both literacy and language skills to improve children's school readiness skills.

Despite the need for adequate literacy and language instruction prior to kindergarten, however, publicly-funded pre-k programs have tended to be more successful in promoting literacy than language skills. Evaluations indicated some pre-k programs improved both literacy and language skills, with larger impacts on literacy skills (Hustedt, Jung, Barnett, & Williams, 2015; Weiland & Yoshikawa, 2013; Wong, Cook, Barnett, & Jung, 2008), whereas other programs only improved literacy and not language skills (Peisner-Feinberg et al., 2017). In a randomized controlled trial of the Tennessee state-funded pre-k program, children who participated in the program showed larger effects on literacy measures (effect sizes of 0.41 on decoding and 0.29 on spelling) but smaller effects on language (effect sizes of 0.09 on oral language and 0.20 on vocabulary) at the end of pre-k as compared to control children. Yet, literacy and language skills for the pre-k attenders were no longer significantly higher at the end of kindergarten (Lipsey, Farran, & Hofer, 2015). To address potential shortcomings of publicly-funded pre-k programs in meeting the language and literacy needs of young children, identifying which pre-k teacher instructional practices promote language skills in addition to early literacy skills is vital.

## 2. Instructional practices in pre-k classrooms

A variety of teacher instructional practices have been proposed as important classroom dimensions for children's acquisition of early language and literacy skills (Burchinal, 2017), including frequency and quality of teacher–child language exchanges (Cabell, DeCoster, LoCasale-Crouch, Hamre, & Pianta, 2013; Chien et al., 2010; Early et al., 2010; Wasik & Hindman, 2011), domain-specific learning activities (Burchinal, Zaslow, & Tarullo, 2016; Howes et al., 2008), and use of a variety of activity settings or groupings (Camilli, Vargas, Ryan, & Barnett, 2010). Unpacking the relative contribution of each type of instructional practice to children's language versus literacy skills is important to understand how to help teachers improve these practices in targeted ways that best meet children's needs.

### 2.1. Teacher–child language exchanges

Pre-k teachers have unique opportunities to expose children to language-rich classroom environments, particularly through their efforts in communicating verbally with children. Language exchanges are thought to be foundational for children's development of early language and literacy skills (Dickinson, McCabe, & Essex, 2006). However, multiple studies indicated preschool teachers spent much more time in less stimulating and didactic types of language exchanges than in stimulating types of language exchanges (Chien et al., 2010; Justice, McGinty, Zucker, Cabell, & Piasta, 2013; Ratcliff et al., 2017; Rosemary & Roskos, 2002; Turnbull, Anthony, Justice, & Bowles, 2009). Furthermore, studies

that documented individual children's experiences have suggested that children infrequently engage in verbal exchanges, regardless of the quality of those exchanges, with teachers in pre-k classrooms (Chien et al., 2010). For example, lead teachers in urban child care centers were observed engaging in verbal exchanges involving sharing or requesting information with individual children, on average, in less than one 30-s cycle of a 25-min observation period (Sawyer et al., 2017). Sawyer and colleagues reported that the most frequent type of verbal exchange involved giving directions, which occurred only slightly more often.

Considerable evidence relates the quality of teacher–child language exchanges to children's early language and/or literacy development (Dickinson, Darrow, & Tinibu, 2008; Dickinson & Porche, 2011), although studies have measured teacher–child language exchanges in a number of different ways. Of the studies that focused on children's language skills, preschool children showed larger gains in vocabulary skills within the academic year when their teachers used more elicitations and extensions (Cabell, Justice, McGinty, DeCoster, & Forston, 2015). Similarly, preschool children demonstrated greater gains in vocabulary, but not grammar, across two years, pre-k and kindergarten, when pre-k teachers used more communication-facilitation behaviors (e.g., open-ended questions; Justice, Jiang, & Strasser, 2018). Of the limited studies that focused on literacy skills, Goble et al. (2016) found higher levels of literacy skills when preschoolers engaged in more teacher–child conversations during child-managed contexts. Importantly, an individual child's ability to make gains in language and/or literacy skills is likely a factor of how his or her initial literacy and language skills interact with teachers' language input (Johanson, Justice, & Logan, 2016). Further, language exchanges are bidirectional, with teachers influencing how children use language and children influencing how teachers respond (Justice, McGinty et al., 2013). Differences in how English-speaking children and dual-language learners benefit from teacher language have also emerged (Bowers & Vasilyeva, 2011).

### 2.2. Domain-specific learning activities

Learning activities in pre-k classrooms that target the domains of language and literacy may include activities that are designed to help children improve oral language and vocabulary skills, engage children in sound-focused or writing skills, and expose children to print-rich environments. These activities may take place in large groups, small groups, centers, or by individual children. The frequency of literacy and language domain-specific learning activities in pre-k classrooms has tended to be small. In previous studies conducted in urban settings, literacy activities were observed during 15% of cycles and shared reading during 16% of cycles (Cabell et al., 2013), and activities with a reading readiness focus were observed during 15% of observations (Farran, Meador, Christopher, Nesbitt, & Bilbrey, 2017). Chien et al. (2010) found that children were read to 5% of the observed time, engaged in letter-sound activities 4% of the time, and were involved with prereading 3% of the time.

Nonetheless, more pre-k classroom time spent in language and literacy has been associated with higher gains in those domains. For example, in a large pre-k study, children's letter-naming skills were higher when children engaged in more letter-sound activities. More time spent in oral language activities was related to children's teacher-rated oral language skills (Howes et al., 2008). In an intervention study that helped teachers monitor language experiences for preschool children, treatment status did not predict children's language outcomes. However, children who were identified as receiving more language-learning opportunities showed significantly greater improvements in receptive vocabulary (Strasser, Mendive, Vergara, & Darricades, 2018).

### 2.3. Activity settings

In most pre-k classrooms, three activity settings where language and literacy learning activities are likely to occur include large-group settings, small-group settings, and free choice/center settings. These activity settings have been observed with variable frequency in pre-k classrooms and have had varying associations with child language and/or literacy outcomes.

#### 2.3.1. Large-group settings

Large-group settings generally include at least half or all of the children in the classroom, such as during daily “circle time,” where the teacher (often the lead teacher) engages in the children in thematic content, academic instruction, and social interactions (Ansari & Purtell, 2017; Booren, Downer, & Vitiello, 2012). When children spend time in large-group settings, they may have enhanced exposure to print materials (books, calendar), oral language (singing, storytelling), and literacy (letter- and sound-focused activities; Cabell et al., 2013). Studies in primarily urban settings have found that pre-k children spent at least a quarter of their day in large-group settings (Booren et al., 2012; Chien et al., 2010). Other studies have shown even higher frequencies of large-group settings, such as 37% (Cabell et al., 2013) and 43% (Sawyer et al., 2017) of observed cycles.

Few studies have explored the relationship between teachers' use of large-group settings and child outcomes. Observers' reports of children's engagement with literacy during large-group settings in rural and urban Head Start classrooms was positively associated with expressive vocabulary, reading decoding, and phonological awareness skills (Baroody & Diamond, 2016). A recent kindergarten study found that classrooms marked by a large proportion of time spent in teacher-directed whole group activities was positively related to a language and literacy composite outcome (Ansari & Purtell, 2017). A greater proportion of time spent in teacher-directed activities during large-group settings predicted preschool children's gains in print knowledge and phonological awareness, but not receptive language (Goble & Pianta, 2017).

#### 2.3.2. Small-group settings

Small-group settings generally include teacher-led activities with a smaller number of children and peers. The teacher (often the lead teacher) may organize small-group settings to engage children in structured projects, such as those related to art, cooking, or science (Barnes, Grifenhagen, & Dickinson, 2016). When children spend time in small-group settings, they may have increased opportunities to communicate with peers and teacher(s) in language- and literacy-focused activities. Ideally an adult in the classroom would use small-group settings to enhance children's language skills by scaffolding their language use. In addition, teachers may be more likely to monitor how children accomplish discrete tasks (e.g., targeted skills such as letter identification) and thus small-group settings may be associated with gains in particular literacy skills (Barnes et al., 2016; Early et al., 2010). Studies have found that pre-k children living in urban areas spent a small portion of their day interacting with teachers in small-group settings (Farran et al., 2017). Estimates ranged from as little as 3.5% (Cabell et al., 2013) to as many as 13% of observed cycles (Sawyer et al., 2017). In full-day classroom observations, Farley, Piasta, Dogucu, and O'Connell (2017) found that teachers of 3- to 5-year-olds spent less than 12 min per day in small-group literacy instruction.

Despite low frequencies, small-group instruction is an aspect of early childhood interventions that has been associated with language gains across the pre-k year (Camilli et al., 2010). However, few studies have explicitly studied small-group settings in relation to language, and in particular, literacy outcomes. In a study of preschool settings, children who engaged in relatively equal

proportions of free-choice settings and teacher-directed settings (including small groups) had higher receptive language outcomes at the end of the year (Fulgini, Howes, Huang, Hong, & Lara-Cinisomo, 2012).

#### 2.3.3. Free choice/center settings

Free choice/center settings are those in which children are able to select their own activities, often choosing among various centers, such as dramatic play, blocks, writing, art, science, or puzzles and manipulatives (Turnbull et al., 2009). Children may play by themselves or with peers, and may or may not experience interactions with adults (Booren et al., 2012). Studies have regularly found that children in mainly urban pre-k programs spent approximately a third of their day in free choice settings. As examples, children were observed in free choice/center settings during 28% (Sawyer et al., 2017), 30% (Chien et al., 2010), and 32% (Cabell et al., 2013; Goble & Pianta, 2017) of cycles.

Despite the relatively greater frequency of free choice/center settings, children tend to have fewer language exchanges with their teachers when involved in free choice/center play, even if teachers are present (Booren et al., 2012). Children have been shown to make lowest gains in language and literacy when profiled in a category marked by high free play (Chien et al., 2010). In another study, more time spent in free choice was related to lower vocabulary gains; however, when teachers displayed greater instructional support during free choice, children had higher vocabulary gains (Goble & Pianta, 2017). Child-driven free choice play is frequently considered ideal for promoting children's language, social, and academic development (Bohart, Charner, & Koralek, 2015; Ginsburg, 2007). Recent evidence nonetheless implicates the need for more intentional teaching of language and literacy skills to enhance children's skills as they approach kindergarten (Burchinal, 2017).

#### 2.3.4. Moderation by classroom activity settings

Previous studies have found differences by activity settings for teacher-child language exchanges (Booren et al., 2012; Dickinson, Hofer, Barnes, & Grifenhagen, 2014) and teachers' use of learning activities (Barnes et al., 2016). Large-group settings in pre-k classrooms have been characterized by the most frequent occurrences of teacher talk, including teachers using the most diverse vocabulary words and academic decontextualized language (Barnes et al., 2016). In addition, teachers have been shown to employ the most effective literacy interactions during large-group settings (Cabell et al., 2013). Small-group settings in pre-k classrooms have been characterized by teachers employing more skills-based literacy interactions with children (Barnes et al., 2016). Professional development interventions that focused on enhancing teachers' language and literacy instruction have shown that pre-k teachers were able to produce higher language (Camilli et al., 2010) and literacy (Piasta & Wagner, 2010) gains when the interventions were delivered in small-group settings. However, much less is known about the nature of these relationships within state-funded pre-k programs.

## 3. Rural context

Understanding the degree to which rural programs are able to enhance children's language and literacy skills – and thus promote school readiness – is important because children living in rural areas are less likely to succeed academically than children living in other areas of the US (Clarke et al., 2017; Miller & Votruba-Drzal, 2013). Studies that have examined data from the nationally-representative Early Childhood Longitudinal Study, Birth Cohort (ECLS-B) have shown lower literacy skills in kindergarten for children living in rural versus suburban and/or small urban areas (Clarke et al., 2017; Miller & Votruba-Drzal, 2013).

Children living in rural versus non-rural NC were more likely to be retained in kindergarten and first grade and have lower first and second grade reading proficiency (NC Rural Health Leadership Alliance, 2017). These findings point to the need to understand what is occurring in child care settings in rural areas and which aspects of those settings may be associated with gains in important language and/or literacy skills prior to kindergarten.

Publicly-funded pre-k may be particularly important for children living in rural areas marked by high poverty because it provides an affordable option for families to expose their children to educational settings shown to benefit children's early skills (Phillips et al., 2017). Nearly half of the U.S. rural population lives in the South, the geographic area captured in the current paper, which also has the highest rural poverty rates in the country (Bishaw & Posey, 2016). In particular, children living in rural areas in NC had higher poverty rates than children living in non-rural areas (34% versus 25%; NC Rural Health Leadership Alliance, 2017). In many rural areas, children have reduced exposure to settings that would enhance their language-and literacy-learning opportunities (Justice, Jiang, Khan, & Dynia, 2017; Vernon-Feagans, Gallagher, & Kainz, 2010), thereby increasing the importance of state-funded pre-k programs.

To our knowledge, few studies have examined if differences in teachers' instructional practices exist in rural versus urban/suburban pre-k classrooms, thereby differentially influencing the degree to which children benefit from pre-k programs across regions. Rural programs tend to struggle with transportation costs, recruitment and retention of highly-qualified teachers, and provision of professional development that would enhance teachers' instructional practices (National Advisory Committee on Rural Health and Human Services, 2012). Nonetheless, children in rural NC have been shown to be just as likely to attend a highly-rated child care setting as their non-rural peers (NC Rural Health Leadership Alliance, 2017), suggesting potential similarities in classroom practices across geographic regions. An older study showed that low-income children living in rural areas in Georgia experienced increases in reading scores due to the availability of universal pre-k in the state (Fitzpatrick, 2008). Availability and uptake of pre-k may be important for children in rural communities (Fitzpatrick, 2010), but the degree to which those benefits are conferred because of teachers' instructional practices is largely unknown. By understanding the features of pre-k classrooms that promote children's language and/or literacy development, teacher professional development interventions can be developed and targeted to optimize rural teachers' classroom practices and increase the benefits of pre-k (Dickinson et al., 2008).

#### 4. Current study

The current study contributes to the literature exploring the effects of publicly-funded pre-k programs on school readiness skills in a number of ways, including using data from a recently-conducted study of pre-k in the rural US. Children in the study attended pre-k in six rural districts in the Southeastern US in 2016–17, making this investigation relevant to current contexts of pre-k policies and practices. This study was interested in understanding how potentially-malleable elements of pre-k classrooms might be related to children's acquisition of language and/or literacy skills, specifically focusing on teacher-child language exchanges, domain-specific learning activities, and activity settings. We descriptively explored how frequently these elements were observed in rural classrooms, because few studies have disaggregated data by geographic location. We asked the following research questions: (1) *How often did children in rural pre-k classrooms experience different types of language exchanges with their*

*teacher, domain-specific learning activities, and activity settings?* and (2) *What was the frequency of teacher-child language exchanges and domain-specific learning activities by type of activity setting?* Based on previous studies in mainly urban settings, we hypothesized that children attending rural pre-k programs would experience low frequencies of language exchanges with their teachers, language and literacy learning activities, and small-group settings, but relatively high frequencies of large-group settings and free choice/center settings.

In addition, we inferentially examined the associations of teacher-child language exchanges, learning activities, and activity settings with children's language and literacy outcomes at the end of pre-k and further explored whether the relations of teacher-child language exchanges and learning activities with language and literacy outcomes varied by type of activity setting. We asked two additional research questions: (3) *Did children show larger gains in language and/or literacy skills when they experienced more frequent language exchanges with their teacher, a higher proportion of learning activities (language, sounds, literacy), or a higher proportion of activity settings (large group, small group)?* and (4) *Were teacher-child language exchanges or domain-specific learning activities moderated by the activity settings of whole group and small group?* We hypothesized that regardless of activity setting, children who experienced more language exchanges with their teacher or who engaged in more language and literacy learning activities would have higher spring scores on language and/or literacy measures. We additionally hypothesized that the combination of large-group settings and a higher frequency of teacher-child language exchanges or more time spent in learning activities would be positively related to children's language and literacy outcomes. Finally, we hypothesized that more time in small-group settings in combination with more teacher-child language exchanges or more language and literacy learning activities would produce the highest language and literacy gains for children.

## 5. Method

### 5.1. Participants

The current study included the year one sample from a longitudinal pre-k to third grade study designed to investigate the early learning experiences of rural children and identify policies and practices that promote school success. The longitudinal study involved randomly selecting and recruiting 63 pre-kindergarten classrooms in six rural counties in North Carolina, and recruiting up to six children per classroom to follow from pre-k through third grade. The number of classrooms recruited per county was selected in proportion to the number of publicly-funded pre-k classrooms within that county. In participating classrooms, teachers sent home parent consent forms, and six children were randomly selected to participate among those with parent consents. Special attention was paid to recruit Spanish-English dual language learners (DLLs) in the classrooms that included DLL children. This resulted in 63 classrooms with 366 children in the fall (29% DLLs). In the spring, 89 children (11.6% DLLs, 7.9% non-DLLs) were included from those with parent consents to replace children lost due to attrition and to increase the numbers of DLL children. Our final sample consisted of 455 children (36% DLLs). Attrition across the course of the year was minimal (0.4% DLLs, 2.8% non-DLLs).

### 5.2. Procedures

Trained data collectors administered individual assessments to children in the fall and/or spring. Data collectors observed classrooms during a one-day visit in the winter (January through March).

Classroom observations were scheduled during the morning hours (typically a 3-h period in each classroom), when children and teachers were most likely to be engaged in language and instructional activities that might be comparable across classrooms. Teachers and parents were surveyed in the fall and spring. Teachers completed surveys online. Parent surveys were sent home by teachers and returned in sealed envelopes, which were returned to the data collectors who conducted child assessments.

### 5.3. Measures

#### 5.3.1. Classroom observations

Data on *teacher–child language exchanges*, *domain-specific learning activities*, and *activity settings* were obtained from a classroom observation tool called the Language Interaction Snapshot (LISn; Sprachman, Caspe, & Atkins–Burnett, 2010). The LISn was designed to capture language and instruction in early childhood classrooms as experienced by selected children, in contrast to global quality measures that examine interactions experienced by all children in the classroom. The LISn involved observing a given child for 30 s to record language exchanges, and repeating these 30-s cycles 10 times, for a total of 5 min of observation (called “snapshots”). Data collectors marked the presence of each type of language that occurred during a 30-s cycle of observation for each individual child. They indicated all of the categories of language that the child experienced from different conversational partners during that observation period. Multiple codes were allowed during each 30-s cycle. However, once a particular code was used in the 30-s cycle, data collectors did not mark it again in a 30-s cycle, though it may have been marked in the next 30-s cycle. Instances also occurred during a 30-s cycle when the target child was playing or working alone and did not talk to anyone and no one talked to him/her. During these 30-s cycles, data collectors were unable to mark any teacher–child language exchanges. Nonetheless, these cycles were included as part of the data because they reflected the child’s experiences in the classroom.

At the end of the 5-min snapshot, the observer recorded the learning activities and activity settings observed during the snapshot. The observer then observed 2–5 additional children, each for 10 cycles of 30 s to collect 5-min snapshots for each participant. The observer repeated these snapshots of the selected children for a total of 120 min (20–30 min per child). LISn training involved two days of classroom instruction and two days of classroom observation practice and reliability sessions. Certification involved obtaining 90% agreement across items with the trainer. Weighted kappas were computed from 20% of reliability observations.

##### 5.3.1.1. Teacher–child language exchanges.

During each 30-s cycle, data collectors coded lead teachers’ language exchanges, or verbal communication, with the selected child. Language exchanges could be directed to the selected child alone. Alternately, teacher verbalizations were coded as experienced by the selected child if the child was in close proximity and paying attention to the lead teacher in a large or small group of other children. An exception to the latter was if the teacher obviously directed verbalizations to another child. For this study, we were interested in the language exchanges provided by the lead teacher in English and combined the following five codes to comprise *teacher–child language exchanges*: *repeats or confirms*; *gives verbal directions*; *provides information, labels, or names*; *requests language or comprehension*; and *provides or elicits information*. Reliability at the item level for codes capturing each type of teacher language exchange was calculated using Cohen’s kappa coefficient ( $\kappa$ ). For *repeats or confirms*, teachers were coded as repeating one or more exact words used by the selected child without adding additional information or acknowledging the selected child’s talk ( $\kappa = 0.65$ ).

For *gives verbal directions*, teachers were coded as using instructions to prompt the selected child to carry out a task ( $\kappa = 0.76$ ). For *provides information, labels, and names*, teachers were coded as providing contextual cues about objects or actions in the classroom environment ( $\kappa = 0.70$ ). For *requests language or comprehension*, teachers were coded as asking information and expecting a verbal or nonverbal response from the selected child ( $\kappa = 0.82$ ). For *provides or elicits information*, teachers were coded as requesting information from or providing information to the selected child based on decontextualized cues outside of the classroom environment, such as tapping into children’s existing knowledge or experiences or making speculations about the future ( $\kappa = 0.52$ ). Teacher–child language exchange variables represented each construct at the classroom level. The proportion of 30-s cycles per 5-min snapshot in which teacher–child language exchange codes were observed was computed for each child in each classroom. The mean of all 5-min snapshots for teacher–child language exchanges was computed per child, and then those means were averaged across all observed children in each classroom.

The following measures were used in analyses. Descriptively, we were interested in exploring how frequently children experienced each type of teacher language exchange, particularly during the activity settings of small group, large group, and free choice/centers. Analytically, we were initially interested in how frequently teachers engaged children in language exchanges that could be considered more or less stimulating. Given overall low frequencies of language exchanges, however, we took the mean of all captured teacher–child language exchanges (i.e., repeating child talk, giving verbal directions, requesting language, labeling and naming, and eliciting information) to create one composite to understand the association of *teacher–child language exchanges* with children’s language and literacy growth over their pre-k year. Cronbach’s alpha for the composite of *teacher–child language exchanges* was  $\alpha = 0.82$ .

##### 5.3.1.2. Domain-specific learning activities.

At the end of each 5-min snapshot, data collectors completed a context form, marking one or more *learning activities* in which each selected child participated. We were most interested in children’s time spent in language and literacy learning activities, as measured by *oral language/vocabulary*, *sounds*, *writing*, and *print-related* activities. For *oral language/vocabulary*, the child was coded as participating in an activity or activities that did not involve print materials, such as telling or listening to a story, taking part in a discussion, asking or answering question, or learning new words ( $\kappa = 0.63$ ). For *sounds*, the child was coded as participating in an activity or activities related to learning, naming, or using sounds, such as learning alphabet sounds; naming sounds that they hear; rhyming; or indicating syllables ( $\kappa = 0.91$ ). For *writing*, the child was coded as participating in an activity or activities that included children using letters and words to communicate, such as writing, pretend writing, or copying ( $\kappa = 0.97$ ). For *print-related*, the child was coded as participating in an activity or activities that included reading texts, sight reading, and alphabet work ( $\kappa = 0.92$ ). Domain-specific learning activity variables represented each construct at the classroom level. The mean of all 5-min snapshots for domain-specific learning activities was computed per child, and then those means were averaged across all observed children in each classroom.

The following measures were used in analyses. Descriptively, we were interested in exploring how frequently children participated in each learning activity, particularly during the activity settings of small group, large group, and free choice/centers. Analytically, we included learning activities that were conceptually related with particular outcomes to understand associations with children’s language and literacy growth over their pre-k year. Thus,

for the associations with the expressive language outcome, we used *oral language/vocabulary*; for the reading decoding outcome, we created a composite by taking the mean of three activities (*sounds*, *writing*, and *print-related*) to depict *literacy*; and for the phonemic awareness outcomes, we used *sounds*.

### 5.3.1.3. Activity settings.

On the context form completed at the end of each 5-min snapshot, data collectors also marked one or more *activity settings* in which each selected child participated. The full list of *activity settings* included time spent in *large group*, *small group*, *individual time*, *free choice/center time*, *routines*, and *meals/snacks*. For the purposes of this study, we were most interested in settings that could be considered “instruction-based” (e.g., designed to promote children’s learning) and that were observed on average for more than 5% of the observation period within classrooms. Thus, we retained the activity settings of *large group*, *small group*, and *free choice/center time*. In *large-group settings*, the child participated in a teacher-led activity or activities in which more than half the class was involved ( $\kappa = 0.90$ ). In *small-group settings*, the child participated in a teacher-led activity or activities in which less than half the class was involved ( $\kappa = 0.88$ ). In *free choice/center settings*, the child selected his/her own activity or activities, which were frequently observed during center time ( $\kappa = 0.96$ ). Activity setting variables represented each construct at the classroom level. The mean of all 5-min snapshots for activity settings was computed per child, and then those means were averaged across all observed children in each classroom.

The following measures were used in analyses. Descriptively, we were interested in exploring how frequently children in our rural pre-k sample experienced each of these three activity settings, along with the frequency of teacher–child language exchanges and learning activities within each setting. Analytically, we focused on two instructional settings, *large group* and *small group*, as predictors of children’s language and literacy growth over their pre-k year and as moderators of teacher–child language exchanges and domain-focused learning activities. Although we were also interested in modeling *free choice/center time* in analytic models, it was highly negatively correlated with *large group*. As such, it was not possible to include both variables in analytic models because of their confounded nature. Our primary models included large-group settings, but we modeled free choice/center in sensitivity analyses.

### 5.3.2. Academic outcomes

Expressive language skills of selected children were assessed using English and Spanish-English bilingual versions of the *Expressive One-Word Picture Vocabulary Test* (EOWPVT; Brownell, 2000). EOWPVT measured children’s ability to name presented objects, actions, or concepts. Internal consistency reliability for the normed sample ranged from 0.96–0.98, and test-retest reliability was 0.95 (Brownell, 2000). Spring standardized scores for the English and bilingual versions were combined for analyses.

Reading decoding skills of selected children were assessed using the *Letter-Word Identification* subtests of the Woodcock Johnson Woodcock, McGrew, and Mather (2001). WJ Letter-Word Identification measured children’s ability to distinguish letter sounds and words correctly. Initial items required the child to identify letters that appeared in large type. Remaining items required the child to read words correctly, with items becoming increasingly difficult as the selected words appear less commonly in written English. Median test reliability for the normed sample was 0.94 (Schrank, McGrew, & Woodcock, 2001). Spring standardized scores were used in analyses.

Initial-sound knowledge and phonemic awareness skills of selected children were assessed using two subtests from the Dynamic Indicators of Basic Early Literacy Skills (DIBELS Next; Good

et al., 2011): *First Sound Fluency* (FSF) and *Phoneme Segmentation Fluency* (PSF). FSF measured children’s ability to orally distinguish as many initial sounds of words as possible within one minute. Alternate-form reliability for a pre-k sample was 0.86 (Cummings, Kaminski, Good, & O’Neil, 2011). PSF measured children’s ability to orally segment as many sounds within words as possible within one minute. Alternate-form reliability for a kindergarten sample was 0.88 (Kaminski & Good, 1996). At the time of data collection for this study, FSF and PSF subtests were not benchmarked for pre-k and pre-k versions of these assessments were not available; thus, we used the subtests benchmarked for kindergarten. Spring continuous measures of FSF and PSF were used in analyses.

### 5.3.3. Control variables

Child and family control variables were included in analytic models. To account for differences in skill levels at the beginning of the preschool year, the child’s fall score on each respective outcome measures was included as a covariate. Additional covariates were child *gender* (0 = female, 1 = male), child *race* (entered as four binary variables of White, Black, Hispanic/Latino, and Other), *dual language learner* (0 = no, 1 = yes), and *maternal education* (a categorical variable where 1 = eighth grade or less; 2 = some high school, but no diploma; 3 = high school graduate [diploma or GED]; 4 = some college [but no degree], 5 = associate’s degree, 6 = bachelor’s degree, and 7 = master’s degree).

## 5.4. Analytic plan

Both descriptive and inferential analyses were conducted using SAS 9.3. The proportion of time children experienced a variety of language exchanges with the lead teacher, time spent in learning activities, and time spent in activity settings were presented descriptively. Inferential analyses were conducted using two-level hierarchical linear model (HLM) analyses. Multiple imputations were conducted to account for missing data, which ranged from 3 to 5% on outcome variables and from 0 to 21% on predictor variables. Multiple imputation has been shown to be the best estimating option to alternative ways of addressing missing data issues, such as listwise deletion or mean substitution (Graham, Olchowski, & Gilreath, 2007; Schafer & Graham, 2002). In the multiple imputation procedure, Bayesian simulation (i.e., Monte Carlo Markov Chain) was used to estimate the unknown multivariate normal parameters in two stages, estimating the mean vector and variance-covariance matrix. In the first stage, missing data on each variable was computed as the predicted values from a regression analysis of that variable from all variables in the model as well as auxiliary variables representing school district and additional academic measures. In the second stage, the variance-covariance matrix was estimated from the variables including the imputed values. This process was repeated until changes across cycles were miniscule. Using this approach, 20 separate imputation data sets were created. The HLM analyses were conducted within each dataset, and then parameter estimates and their standard errors were combined across datasets using the MI procedures in SAS.

Separate HLM models were conducted for each outcome. Within each model, Level 1 described the child’s spring outcome as a function of his or her fall score on that outcome, with child gender, child race, home language, and maternal education as covariates. The nesting of children in classrooms was represented by random-effects classroom intercepts. Separate analyses for each outcome tested the extent to which the child’s spring scores, given the child’s fall score and other covariates, were related to teacher–child language exchanges, domain-specific learning activities, or activity settings. Variables of interest across all models included Level 2 variables of the composite of *teacher–child language exchanges*;

learning activities of *oral language/vocabulary*, *sounds*, or the composite of *literacy*; and activity settings of *large group* and *small group*. Main effects for these predictors were tested in Model 1, and moderation of learning activities and teacher–child language exchanges by activity settings was tested in Model 2. Effect sizes for significant fixed effects were calculated using Hedges' *g* (Hedges, 1981).

## 6. Results

### 6.1. Descriptive results

Descriptive information for study variables is presented in Table 1. About half of the children were male and about half were female. Parents selected one or more ethnic/racial groups for their child, and the sample included 43% Hispanic/Latino children, 43% White/non-Hispanic, 34% African American/non-Hispanic, and 4% other ethnic/racial group (e.g., Asian or American Indian). Of the sample, 36% had English/Spanish dual language status. Maternal education ranged from less than a high school degree (24%) to a college degree or higher (12%), with about half reporting a high school degree or equivalent.

Table 2 describes the observations of classrooms using the LISn. The frequency of different types of teacher–child language exchanges, domain-specific learning activities, and activity settings were tallied at the classroom level, and then examined across classrooms to answer research question 1 (*How often did children in rural pre-k classrooms experience different types of language exchanges with their teacher, domain-specific learning activities, and activity settings?*). The proportion of teacher–child language exchanges was lowest for providing or eliciting information (2%) and highest for giving verbal directions (14%). Children were observed in print-related learning activities most frequently (18%), followed by oral language/vocabulary activities (9%), sound-focused activities (5%), and writing activities (5%). Children were observed in free choice/center time most frequently (49%), followed by large group (35%), and small group (8%).

Table 3 presents correlations among LISn classroom observation variables, which were included to describe how teacher–child language exchanges, domain-specific learning activities, and activity settings were related. Given that individual indicators of teacher–child language exchanges were highly correlated ( $r$ 's = 0.55–0.81), all teacher language variables were combined into one composite in multilevel analyses. Learning activities were less highly correlated with each other ( $r$ 's = 0.12–0.41). For activity settings, large-group settings were negatively correlated with both small-group settings ( $r = -0.27$ ) and free choice/centers ( $r = -0.61$ ). Because of the large correlation between large-group settings and free choice/centers, we included additional descriptive information about free choice/centers, our primary models included large-group settings, and we included free choice/centers in sensitivity analyses.

The next set of descriptive analyses addressed research question 2 (*What was the frequency of teacher–child language exchanges and domain-specific learning activities by type of activity setting?*). The frequencies of different types of teacher–child language exchanges in different types of activity settings are reported in Fig. 1. Across settings, lead teachers rarely engaged in providing or eliciting decontextualized information from children (e.g., using questions or statements that drew on children's past or future experiences). This type of language exchange was most commonly observed during large-group settings, and even then, for less than 2% of the observed exchanges within classrooms. In contrast, in large-group settings, lead teachers' language exchanges were almost evenly split among giving verbal directions (e.g., asking a child to

perform a routine behavior); requesting a child to respond with language or demonstrate comprehension (e.g., asking a child for the name of an item); or providing information, labels, or names (e.g., naming objects present in the classroom). These types of language exchanges were each observed for approximately 8% of the exchanges within large-group settings. In small-group settings, lead teachers were infrequently observed giving verbal directions, requesting language or comprehension, or providing information (1–2% of the exchanges). Finally, in free choice/center time, children experienced a limited amount of lead teacher language exchanges, ranging from less than 1% for providing or eliciting information to approximately 4% for giving verbal directions.

The frequencies of different types of domain-specific learning activities in different types of activity settings are reported in Fig. 2. Across all settings, print-related activities (e.g., reading a book) were most commonly observed. During large-group settings, children were observed spending 11% of time on print-related activities, 6% on oral language/vocabulary, 3% on sounds, and less than 1% on writing. During small-group settings, children were observed spending less than 2% of time on any of the learning activities. During free choice/center time, children were observed spending 5% of time on print-related activities and less than 2% of time on any of the remaining learning activities.

### 6.2. Multilevel analyses and results

Analyses of child outcomes were conducted to address research questions 3 and 4 (*Did children show larger gains in language and/or literacy skills when they experienced more frequent language exchanges with their teacher, a higher proportion of learning activities (language, sounds, literacy), or a higher proportion of activity settings (large group, small group)? Were teacher–child language exchanges or domain-specific learning activities moderated by the activity settings of whole group and small group?*). Tables 4 and 5 present results from multilevel analyses associating teacher language exchanges, learning activities, and activity settings with children's pre-k outcomes. These analyses accounted for nesting of children in classrooms; children's fall scores on selected outcomes; and child gender, child race, home language, and maternal education as covariates.

#### 6.2.1. Expressive language (EOWPVT)

Children's expressive language skills in the spring as measured by EOWPVT were higher when they experienced more teacher–child language exchanges ( $B = 32.67$ ,  $p = 0.03$ ,  $g = 0.12$ ) and when they spent less time in large-group settings ( $B = -10.76$ ,  $p = 0.04$ ,  $g = -0.12$ ). Time spent in small-group settings and learning activities related to oral language/vocabulary were not associated with expressive language. No evidence of moderation emerged (Model 2).

#### 6.2.2. Reading decoding (WJ Letter-Word Identification)

Children's reading decoding skills in the spring as measured by WJ Letter-Word Identification were higher when they spent more time in small-group settings ( $B = 15.29$ ,  $p = 0.009$ ,  $g = 0.13$ ). Teacher–child language exchanges, learning activities related to literacy, and time spent in large-group settings were not associated with reading decoding. No evidence of moderation emerged (Model 2).

#### 6.2.3. Initial-sound knowledge (DIBELS First Sound Fluency)

Children's initial-sound knowledge in the spring as measured by DIBELS First Sound Fluency was higher when they spent more time in learning activities related to sounds ( $B = 30.53$ ,  $p = 0.004$ ,  $g = 0.15$ ). Teacher–child language exchanges, time spent in large-group settings, and time spent in small-group settings were not associated with initial-sound knowledge.

**Table 1**  
Descriptive data for pre-K sample (N = 455).

| Variable   | Mean or % | SD    | Minimum | Maximum |
|--|-----------|-------|---------|---------|
| Child and family controls                                |           |       |         |         |
| Gender (female = 0, male = 1)                            | 50.55     |       |         |         |
| Race   |           |       |         |         |
| African American   | 33.70     |       |         |         |
| Hispanic/Latino  | 43.46     |       |         |         |
| White  | 43.46     |       |         |         |
| Other (Asian, American Indian)                           | 3.99      |       |         |         |
| Dual language learner (no = 0, yes = 1)                  | 35.82     |       |         |         |
| Maternal education                                       |           |       |         |         |
| Eighth grade or less                                     | 13.06     |       |         |         |
| Some high school, but no diploma                         | 10.59     |       |         |         |
| High school graduate (diploma or GED)                    | 26.58     |       |         |         |
| Some college (but no degree)                             | 27.48     |       |         |         |
| Associate's degree                                       | 10.36     |       |         |         |
| Bachelor's degree  | 7.88      |       |         |         |
| Master's degree  | 4.05      |       |         |         |
| Outcomes   |           |       |         |         |
| Expressive language (EOWPVT), fall                       | 98.68     | 14.78 | 55.00   | 140.00  |
| Expressive language (EOWPVT), spring                     | 100.64    | 14.80 | 65.00   | 145.00  |
| Reading decoding (WJ Letter-Word Identification), fall   | 91.50     | 12.63 | 61.00   | 135.00  |
| Reading decoding (WJ Letter-Word Identification), spring | 95.63     | 11.73 | 59.00   | 143.00  |
| Initial-sound knowledge (DIBELS FSF), fall               | 2.61      | 6.85  | 0.00    | 48.00   |
| Initial-sound knowledge (DIBELS FSF), spring             | 6.31      | 10.06 | 0.00    | 42.00   |
| Phonemic awareness (DIBELS PSF), fall                    | 1.88      | 5.78  | 0.00    | 40.00   |
| Phonemic awareness (DIBELS PSF), spring                  | 4.43      | 8.66  | 0.00    | 58.00   |

Notes: LISn = Language Interaction Snapshot. EOWPVT = Expressive One-Word Picture Vocabulary Test. WJ = Woodcock Johnson. DIBELS = Dynamic Indicators of Basic Early Literacy Skills. FSF = First Sound Fluency. PSF = Phoneme Segmentation Fluency.

**Table 2**  
Variables of interest for pre-K classrooms (N = 61)

| Variable  | Mean or % | SD   | Minimum | Maximum |
|---|-----------|------|---------|---------|
| Predictors of interest (LISn)                       |           |      |         |         |
| Teacher-child language exchanges                    |           |      |         |         |
| Repeats or confirms                                 | 0.05      | 0.04 | 0.00    | 0.21    |
| Gives verbal directions                             | 0.14      | 0.08 | 0.02    | 0.41    |
| Provides information, labels, or names              | 0.13      | 0.08 | 0.00    | 0.40    |
| Requests language or comprehension                  | 0.13      | 0.09 | 0.00    | 0.37    |
| Provides or elicits information                     | 0.02      | 0.02 | 0.00    | 0.11    |
| Composite of teacher-child language exchanges       | 0.09      | 0.06 | 0.02    | 0.26    |
| Domain-specific learning activities                 |           |      |         |         |
| Oral language/vocabulary                            | 0.09      | 0.13 | 0.00    | 0.75    |
| Sounds  | 0.05      | 0.05 | 0.00    | 0.21    |
| Writing   | 0.05      | 0.05 | 0.00    | 0.25    |
| Print-related                                       | 0.18      | 0.12 | 0.00    | 0.50    |
| Literacy composite (sounds, writing, print-related) | 0.09      | 0.06 | 0.00    | 0.31    |
| Activity settings                                   |           |      |         |         |
| Large group   | 0.35      | 0.16 | 0.04    | 0.88    |
| Small group   | 0.08      | 0.10 | 0.00    | 0.38    |
| Free choice/center time                             | 0.49      | 0.19 | 0.04    | 0.92    |

Notes: LISn = Language Interaction Snapshot. EOWPVT = Expressive One-Word Picture Vocabulary Test. WJ = Woodcock Johnson. DIBELS = Dynamic Indicators of Basic Early Literacy Skills. FSF = First Sound Fluency. PSF = Phoneme Segmentation Fluency.

Evidence supporting moderation emerged in Model 2. The interaction between time spent in small-group settings and time spent in sound-focused learning activities was interpreted by testing simple slopes at one standard deviation above and below the moderator mean of small-group settings. As seen in Fig. 3, spring initial-sound knowledge as measured DIBELS First Sound Fluency was higher when children spent more time in small groups regardless of the time spent in sound-focused learning activities ( $t = -0.075, p = 0.94$ ). In contrast, children who were in classrooms where less time was spent in small-group settings and less time was spent in sound-focused learning activities scored lowest on spring initial-sound knowledge. Yet, when children engaged in more sound-focused learning activities despite lower time spent

in small-group settings, they scored higher on spring initial-sound knowledge ( $t = 4.44, p < 0.001, g = 0.30$ ).

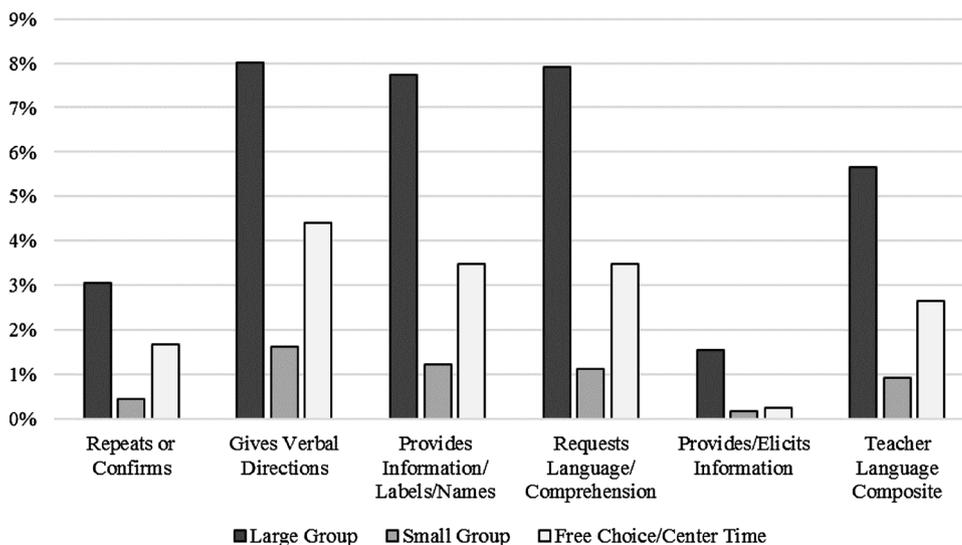
#### 6.2.4. Phonemic awareness (DIBELS Phoneme Segmentation Fluency)

Children's phonemic awareness in the spring as measured by DIBELS Phoneme Segmentation Fluency was higher when they spent more time in learning activities related to sounds ( $B = 23.21, p = 0.009, g = 0.13$ ) and more time in small-group settings ( $B = 9.54, p = 0.03, g = 0.11$ ). Teacher-child language exchanges and time spent in large-group settings were not associated with phonemic awareness. No evidence of moderation emerged (Model 2).

**Table 3**  
Correlation matrix for classroom observation variables.

|   | Teacher–child language exchanges |          |          |          |         |          | Domain-specific learning activities |         |         |         |         | Activity settings |      |
|---|----------------------------------|----------|----------|----------|---------|----------|-------------------------------------|---------|---------|---------|---------|-------------------|------|
|   | 1                                | 2        | 3        | 4        | 5       | 6        | 7                                   | 8       | 9       | 10      | 11      | 12                | 13   |
| Teacher–child language exchanges          |                                  |          |          |          |         |          |                                     |         |         |         |         |                   |      |
| 1. Repeats or confirms                    | –                                |          |          |          |         |          |                                     |         |         |         |         |                   |      |
| 2. Gives verbal directions                | 0.55***                          | –        |          |          |         |          |                                     |         |         |         |         |                   |      |
| 3. Provides information, labels, or names | 0.65***                          | 0.78***  | –        |          |         |          |                                     |         |         |         |         |                   |      |
| 4. Requests language or comprehension     | 0.74***                          | 0.73***  | 0.81***  | –        |         |          |                                     |         |         |         |         |                   |      |
| 5. Provides or elicits information        | 0.64***                          | 0.59***  | 0.68***  | 0.64***  | –       |          |                                     |         |         |         |         |                   |      |
| 6. Composite                              | 0.78***                          | 0.89***  | 0.93***  | 0.93***  | 0.75*** | –        |                                     |         |         |         |         |                   |      |
| Domain-specific learning activities       |                                  |          |          |          |         |          |                                     |         |         |         |         |                   |      |
| 7. Oral language/vocabulary               | 0.00                             | 0.13**   | 0.10*    | 0.24***  | 0.21*** | 0.16***  | –                                   |         |         |         |         |                   |      |
| 8. Sounds                                 | 0.16**                           | 0.20***  | 0.38***  | 0.26***  | 0.33*** | 0.31***  | –0.09                               | –       |         |         |         |                   |      |
| 9. Writing                                | 0.13*                            | 0.10*    | 0.24***  | 0.27***  | 0.30*** | 0.23***  | 0.12*                               | 0.33*** | –       |         |         |                   |      |
| 10. Print-related                         | 0.25***                          | 0.11*    | 0.35***  | 0.41***  | 0.26*** | 0.33***  | 0.01                                | 0.41*** | 0.27*** | –       |         |                   |      |
| 11. Literacy composite                    | 0.26***                          | 0.17***  | 0.43***  | 0.45***  | 0.37*** | 0.39***  | 0.02                                | 0.67*** | 0.59*** | 0.90*** | –       |                   |      |
| Activity settings                         |                                  |          |          |          |         |          |                                     |         |         |         |         |                   |      |
| 12. Large group                           | 0.34***                          | 0.31***  | 0.27***  | 0.42***  | 0.15**  | 0.36***  | 0.34***                             | 0.00    | 0.15**  | 0.19*** | 0.18*** | –                 |      |
| 13. Small group                           | –0.05                            | 0.09     | 0.15**   | 0.06     | 0.23*** | 0.10*    | –0.01                               | 0.03    | 0.15**  | 0.02    | 0.07    | –0.27***          | –    |
| 14. Free choice/center time               | –0.15*                           | –0.31*** | –0.28*** | –0.31*** | –0.18** | –0.31*** | –0.18***                            | –0.12*  | –0.07   | –0.12*  | –0.14** | –0.61***          | 0.07 |

\*  $p < 0.05$ .  
\*\*  $p < 0.01$ .  
\*\*\*  $p < 0.001$ .



**Fig. 1.** Frequency of teacher–child language exchanges during large group, small group, and free choice/center settings relative to the frequency each setting was observed.

6.3. Sensitivity analyses

Additional analyses were conducted to ensure the robustness of the results reported above. Because our sample included a large number of DLLs, we included two-way and three-way interaction terms to test possible differential effects of teacher–child language exchanges, learning activities, or activity settings by DLL status. No evidence of moderation emerged. We also substituted the variable of free choice/center for large-group setting in all models. Free choice/center as a main effect or moderator was not significantly associated with any outcomes, and the positive associations described above between small-group settings and the literacy outcomes remained significant.

7. Discussion

The first aim of this study was to describe how frequently children in rural state-funded pre-k classrooms experienced language exchanges with their lead teachers, participated in learning activi-

ties related to language and literacy domains, and spent their time in various activity settings. The second aim was to examine whether these features of pre-k classrooms were related to residualized gains in children’s language and/or literacy outcomes in analyses that included the fall score on the outcome and child and family characteristics as covariates. We also investigated whether activity setting (large-group and/or small-group settings) moderated teacher–child language exchanges and learning activities. Overall, we observed low frequencies of teacher–child language exchanges across pre-k classrooms, particularly teacher language that might be considered more stimulating (i.e., requesting language or comprehension, providing or eliciting information). Children were most likely to engage in print-related learning activities and spend their time in free choice/center or large-group settings. In our inferential analyses, we found the following: (1) Teacher–child language exchanges were positively associated with expressive language skills, but not reading decoding or phonemic awareness skills. (2) Only one type of domain-specific learning activity, sound-focused activities, was related to two early literacy skills, identifying initial

**Table 4**  
Multilevel model results for expressive language (EOWPVT) and reading decoding (WJ Letter-Word Identification) for pre-K sample (N = 455).

| Variable   | Expressive language (EOWPVT) |        | Reading decoding (WJ Letter-Word Identification) |        |
|--|------------------------------|--------|--|--------|
|  | B                            | SE     | B  | SE     |
| <b>Model 1, main associations</b>                |                              |        |  |        |
| Fall scores                                      |                              |        |  |        |
| Expressive language (EOWPVT)                     | 0.63***                      | 0.04   | –  | –      |
| Reading decoding (WJ Letter-Word Identification) | –                            | –      | 0.60***  | 0.04   |
| Child and family controls                        |                              |        |  |        |
| Gender (female = 0, male = 1)                    | –0.04                        | 1.02   | –1.84*   | 0.88   |
| Race   |                              |        |  |        |
| African American                                 | –1.02                        | 1.66   | –0.14  | 1.45   |
| Hispanic/Latino                                  | –0.58                        | 2.12   | –0.74  | 1.76   |
| White  | 1.45                         | 1.49   | –0.80  | 1.26   |
| Other  | 0.36                         | 2.65   | 2.08   | 2.33   |
| Dual language learner (no = 0, yes = 1)          | 2.12                         | 2.28   | 1.56   | 1.89   |
| Maternal education                               | –0.31                        | 0.39   | 0.37   | 0.35   |
| Predictors of interest (LISn), classroom level   |                              |        |  |        |
| Teacher–child language exchanges                 | 32.67*                       | 15.38  | 14.11  | 12.05  |
| Domain-specific learning activities              |                              |        |  |        |
| Language   | –11.24                       | 5.89   | –  | –      |
| Literacy composite                               | –                            | –      | 7.50   | 10.49  |
| Activity settings                                |                              |        |  |        |
| Large group                                      | –10.76*                      | 5.26   | 3.01   | 3.80   |
| Small group                                      | 5.36                         | 7.77   | 15.29**  | 5.87   |
| <b>Model 2, moderation analysis</b>              |                              |        |  |        |
| Large group × language exchanges                 | 61.67                        | 75.92  | 71.98  | 61.40  |
| Small group × language exchanges                 | –23.45                       | 138.92 | 75.68  | 123.93 |
| Large group × language learning activities       | –64.59                       | 44.41  | –  | –      |
| Small group × language learning activities       | 131.87                       | 100.53 | –  | –      |
| Large group × literacy learning activities       | –                            | –      | –27.53   | 67.95  |
| Small group × literacy learning activities       | –                            | –      | –80.40   | 105.97 |

Notes: LISn = Language Interaction Snapshot. EOWPVT = Expressive One-Word Picture Vocabulary Test. WJ = Woodcock Johnson.

\*  $p < 0.05$ .

\*\*  $p < 0.01$ .

\*\*\*  $p < 0.001$ .

**Table 5**  
Multilevel model results for initial-sound knowledge (DIBELS FSF) and phonemic awareness (DIBELS PSF) for pre-K sample (N = 455).

| Variable  | Initial-sound knowledge (DIBELS FSF) |        | Phonemic awareness (DIBELS PSF) |        |
|---|--------------------------------------|--------|---------------------------------|--------|
|   | B                                    | SE     | B                               | SE     |
| <b>Model 1, main associations</b>               |                                      |        |                                 |        |
| Fall scores                                     |                                      |        |                                 |        |
| Initial-sound knowledge (DIBELS FSF)            | 0.68***                              | 0.07   | –                               | –      |
| Phonemic awareness (DIBELS PSF)                 | –                                    | –      | 0.61***                         | 0.07   |
| Child and family controls                       |                                      |        |                                 |        |
| Gender (female = 0, male = 1)                   | –2.17*                               | 0.84   | –1.01                           | 0.76   |
| Race  |                                      |        |                                 |        |
| African American                                | –0.85                                | 1.37   | –0.11                           | 1.22   |
| Hispanic/Latino                                 | 1.52                                 | 1.72   | –0.99                           | 1.54   |
| White   | 0.93                                 | 1.17   | 0.77                            | 1.03   |
| Other   | 3.89                                 | 2.25   | 3.14                            | 2.06   |
| Dual language learner (no = 0, yes = 1)         | –2.13                                | 1.86   | –0.73                           | 1.65   |
| Maternal education                              | 0.25                                 | 0.32   | 0.03                            | 0.29   |
| Predictors of interest (LISn), classroom level  |                                      |        |                                 |        |
| Teacher–child language exchanges                | 0.64                                 | 10.32  | 8.80                            | 8.91   |
| Domain-specific learning activities             |                                      |        |                                 |        |
| Sounds  | 30.53**                              | 10.65  | 23.21**                         | 8.85   |
| Activity settings                               |                                      |        |                                 |        |
| Large group                                     | –2.36                                | 3.36   | –3.36                           | 2.92   |
| Small group                                     | 8.57                                 | 5.16   | 9.54*                           | 4.36   |
| <b>Model 2, moderation analysis</b>             |                                      |        |                                 |        |
| Large group × language exchanges                | –2.08                                | 68.10  | 14.95                           | 62.05  |
| Small group × language exchanges                | 132.88                               | 103.62 | 75.08                           | 93.18  |
| Large group × sound-focused learning activities | 81.39                                | 83.87  | 31.11                           | 75.51  |
| Small group × sound-focused learning activities | –291.77*                             | 130.46 | –115.56                         | 115.56 |

Notes: LISn = Language Interaction Snapshot. DIBELS = Dynamic Indicators of Basic Early Literacy Skills. FSF = First Sound Fluency. PSF = Phoneme Segmentation Fluency.

\*  $p < 0.05$ .

\*\*  $p < 0.01$ .

\*\*\*  $p < 0.001$ .

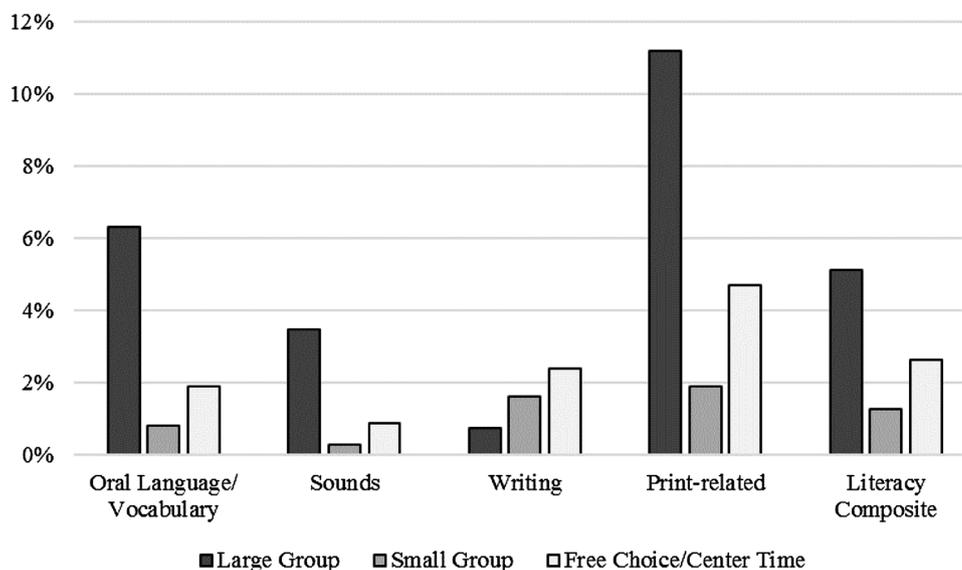


Fig. 2. Frequency of domain-specific learning activities during large group, small group, and free choice/center settings relative to the frequency each setting was observed.

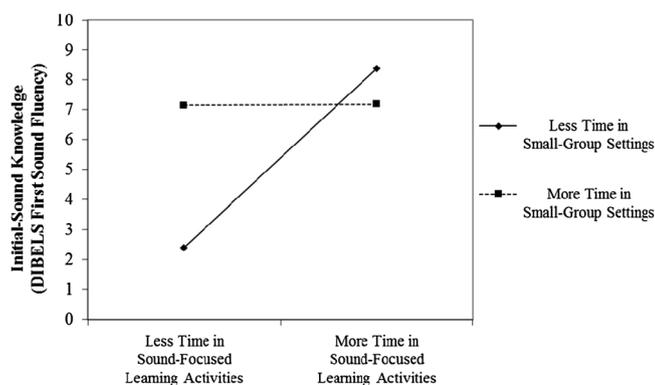


Fig. 3. Time spent in sound-focused learning activities by time spent in small-group settings in association with initial-sound knowledge as measured by DIBELS First Sound Fluency (FSF).

sounds in words and phonemic awareness. (3) For types of activity settings, large-group settings were negatively associated with children's expressive language skills and small-group settings were positively associated with early literacy skills. (4) Tests of moderation revealed only one interaction, with less time spent in both sound-focused learning activities and small-group settings negatively related to initial-sound knowledge. Together, these findings offer insights into the structure and potential benefits of pre-k for children living in rural areas.

This study supports previous findings that teacher-child language exchanges and domain-specific learning activities comprise a small part of children's experience in pre-k classrooms (Chien et al., 2010; Tonyan & Howes, 2003). Across various classroom settings, lead teachers in this study rarely engaged in providing or eliciting decontextualized information from children (e.g., using questions or statements that drew on children's past or future experiences), which can be considered a more advanced type of linguistic interaction or language input that promotes child skills (Cabell et al., 2015; Sprachman et al., 2010). This finding is similar to a recent study in urban child care centers, which used the LISn classroom observation measure and found that lead teachers rarely engaged children in high-quality language exchanges (Sawyer et al., 2017). Although not directly comparable, this suggests that similarities in teacher language input may exist across

rural and urban regions. For children in our study, the combination of all types of teacher-child language exchanges (i.e., our composite of more and less stimulating types of language), was associated with child language skills at the end of pre-k. Observational (Cabell et al., 2015) and intervention (Markussen-Brown et al., 2017) studies have provided support for this relationship. Oral language exposure is an important strategy to help children develop the language skills necessary to become proficient readers (Language and Reading Research Consortium, 2017). Promoting higher frequencies of teacher-child language exchanges in pre-k classrooms across geographic regions may be one way to enhance children's early language skills. Even doubling how frequently teachers engage with children in language exchanges (e.g., in this study, from 9% to 18% of observed interactions) could have meaningful impacts for children.

In contrast, large-group settings were negatively associated with children's expressive language skills, which is contrary to findings from other studies in Head Start (Baroody & Diamond, 2016) and kindergarten classrooms (Ansari & Purcell, 2017). For example, Baroody and Diamond showed that children's observed engagement in literacy-focused activities in large-group settings was associated with expressive language and literacy outcomes for rural and urban Head Start students (Baroody & Diamond, 2016). In our study, however, we did not capture individual children's level of engagement during the large-group activities. Children may have not benefited as much from large-group settings because of how teachers used this time. Descriptively, we found teachers talked more when children were in large-group settings than in small-group settings or free choice/center settings, although still at low overall rates (8% at most). However, the types of language exchanges that were far more frequent in large groups than in the other settings suggested teachers were talking at, rather than with, children in these settings. Although teachers may view large-group settings as a time for academic instruction and a way to introduce new topics (Ansari & Purcell, 2017; Barnes et al., 2016; Early et al., 2010), managing a large number of children may hinder teachers' efforts in using complex language and vocabulary with children. Growing evidence suggests that multi-turn conversations, not simple exposure to language, are especially effective at promoting new language skills (Wasik & Hindman, 2011), and those are unlikely to occur during large-group settings.

This study supported other observational studies in finding that when teachers engaged with children in particular literacy skills (i.e., instruction in letter sounds), children were more likely to make gains in related skills by the end of the pre-k year (Howes et al., 2008). This finding is particularly significant because many early childhood programs focus on hands-on play-based experiences rather than distinct skills-based instruction to promote student learning (Early et al., 2010). Yet, the addition of sound-focused learning activities in pre-k classrooms appeared to be associated with children's ability to produce initial and remaining sounds in words, which has been shown to be predictive of later literacy development (National Early Literacy Panel, 2008). For the outcome of initial-sound knowledge (First Sound Fluency), small-group settings moderated the association of sound-focused activities such that a "low dose" of both small-group settings and sound-focused activities was associated with the lowest scores. Small-group settings were positively associated with the other literacy measures (Letter-Word Identification and Phoneme Segmentation Fluency). Teachers have been shown to use small-group settings to assist and monitor children with discrete skills, such as literacy skills (Barnes et al., 2016; Lou et al., 1996). In meta-analyses of early childhood interventions, small-group instruction in the treatment condition was associated with gains in literacy outcomes (Piasta & Wagner, 2010). Even though teachers in the current study infrequently used small groups as an instructional setting (as shown in Fig. 2), small-group activities related to oral language, writing, and print, in addition to sound-focused activities, may be an important means to assist children with early literacy skills, and should be explored in future work.

### 7.1. Limitations

Some limitations were present in our study. First, this study does not allow for causal inference. As is true in other studies, selection bias may have played a factor in our findings. Second, our sample is not representative of all children in the pre-k programs in these counties. We randomly selected classrooms, but only selected children with parental consent. Although we randomly selected children to participate from those who returned consents, it is possible that children whose families returned consents comprised a substantially different population from the other children in the pre-k programs. Third, we limited our variable of teacher-child language exchanges to only the lead teachers rather than capturing children's language exchanges with all adults in the classroom. Lead teachers, as compared to assistant teachers, have been shown to use more literacy-related language with children (Rosemary & Roskos, 2002), but language exchanges with other adults in pre-k classrooms (e.g., assistants, paraprofessionals, volunteers) nonetheless may be important in understanding how children gain skills over the course of their pre-k year. Fourth, reliability was low for the teacher-child language exchange variable *provides or elicits information*, perhaps because this type of exchange occurred the least frequently in these classrooms. Fifth, the design of the bilingual version of EOWPVT (Brownell, 2000) was such that children were asked to respond in Spanish, but if they did not know the word in Spanish, they could respond in English. We did not record when responses were given correctly in English versus Spanish, and thus we were unable to tease out Spanish versus English growth on our measure. Finally, the LISn classroom observation measure captured whether content areas (i.e., oral language/vocabulary, sounds, writing, print-related) occurred during each 5-min snapshot, but did not measure the proportion of time spent in each content area during those five minutes.

### 7.2. Implications

More research needs to be conducted with rural, urban, and suburban samples that uses targeted observations to understand exactly what – and how – classroom practices are beneficial for children. The use of our classroom observation measure, collected at the individual child level and then aggregated to the classroom, showed that children had a limited number of opportunities to talk with their lead teachers or engage in literacy practices that might benefit specific skills important for kindergarten entry. Although the LISn classroom observation measure provided a more nuanced examination of pre-k classrooms, it only captured a limited amount of classroom experiences, with approximately two hours per classroom. Technological tools that capture naturalistic language exposure in pre-k classrooms over a longer period may be more informative about the benefits of classroom practices for individual children.

Although the effect sizes of our findings were small, this study provides support for the need to help teachers engage with individual children in language exchanges, use language and literacy learning activities, and manage classroom settings to promote children's language and literacy skills. However, providing children with more language exchanges, increased opportunities for learning concrete literacy skills, and small group instruction may not be pedagogical strategies that pre-k teachers readily employ (Markussen-Brown et al., 2017; Wyatt & Chapman-DeSousa, 2017). Early childhood programs, including state-funded pre-k programs, tend to employ teachers with limited education and experience, offer low wages, and experience high rates of teacher attrition (Child Care Services Association, 2015; U.S. Department of Health & Human Services, 2016). Pre-k teachers frequently do not have requisite training to provide the frequency and quality of language exchanges that may be most promising for children's language development.

Professional development opportunities for in-service teachers may be an important means of improving pre-k teachers' instructional practices. Intervention studies have shown that professional development can improve teachers' language exchanges with children in their classroom and, thereby, improve children's language and literacy skills (Powell, Diamond, Burchinal, & Koehler, 2010; Wasik & Hindman, 2011; Zucker, Solari, Landry, & Swank, 2013). Further, evidence has suggested that the focus of professional development (i.e., improving language interactions or literacy instruction) and the intensity of professional development (higher levels of intervention implementation) appears to determine whether children show gains on language or literacy skills (Powell et al., 2010; Wasik, Bond, & Hindman, 2006; Wasik & Hindman, 2011). Thus, professional development opportunities that provide practice-based opportunities integrating the latest research on language and literacy acquisition and working with children and families from diverse cultural, linguistic, and economic backgrounds may be most helpful for pre-k teachers (Whitebrook & Ryan, 2011).

Hands-on professional development, including ongoing coaching to help teachers implement the best evidenced-based practices, may be important for pre-k teachers (Duncan & Murnane, 2014). Support-oriented professional development, which also emphasizes better instructional strategies for pre-k teachers, is critical in order to promote gains for pre-k children in publicly-funded programs frequently serving children from low-income families (Duncan & Murnane, 2011, 2014). Accessing high-quality professional development may be challenging for teachers in rural areas of the United States because of geographic isolation and reduced community and school resources (Child Care Services Association, 2015). One strategy that may benefit rural pre-k teachers is to provide ongoing professional development support (training,

coaching) using webcam technology, which has been shown to be an affordable model positively associated with teacher efficacy and children's literacy skills (Vernon-Feagans, Bratsch-Hines, Bean, Varghese, & Hedrick, 2015).

## 8. Conclusion

Few studies have examined teacher–child language exchanges, domain-specific learning activities, and activity settings in relation to children's language and/or literacy outcomes. Discovering how teachers use language and literacy content in their pre-k classrooms is critical for understanding how children experience and benefit from their time in pre-k. Policy makers funding programs such as the one represented in the current study are often concerned with how children gain concrete and testable school readiness skills, particularly those related to literacy (Early et al., 2010). Findings from this study implied that participation in sound-focused activities and small-group settings were associated with literacy gains for children attending rural state-funded pre-k programs, and having language exchanges with lead teachers was associated with children's language gains. These findings support professional development efforts that focus on varying strategies to promote positive language and/or literacy outcomes for children.

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