Peer effects on dual language learners' English and Spanish receptive vocabulary development

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A R T I C L E   I N F O

A B S T R A C T

Using a nationally representative sample of 3- and 4-year-old Spanish-speaking dual language learners (DLLs) attending Head Start ($N = 654$), this study examined whether mean levels of and variability in peers' English receptive vocabulary skills were associated with DLLs' English and Spanish receptive vocabulary skills in the spring. In addition, I tested whether these associations differed depending on the proportion of DLLs in the class. Results showed that DLLs had better English receptive vocabulary growth, but weaker Spanish receptive vocabulary growth when their classmates had higher English receptive vocabulary skills. Variability in peers' English receptive vocabulary skills was not significantly associated with vocabulary growth in English or Spanish. These patterns did not depend on the proportion of DLLs in the class, pointing to the utility of understanding peer effects in terms of classmates' skills and not only their characteristics. Findings demonstrate the importance of classmates' English vocabulary skills for English vocabulary development. However, additional supports are needed to maintain DLLs' vocabulary development in Spanish.

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Early childhood is a critical period for the acquisition of oral language skills. Oral language skills like vocabulary not only enable children to communicate with others but are a precursor to reading and long-term academic achievement. Understanding factors that can promote early vocabulary development is particularly important among dual language learners (DLLs) – children who are still learning their first language as they are acquiring their second. Relative to English-speaking monolingual children, children who speak a language other than English at home are more likely to live in poverty (Calderón, Slavin, & Sánchez, 2011) and be underserved by educational systems, including preschool (Nores, Friedman-Krauss, & Frede, 2018). Consequently, despite evidence that proficiency in two languages holds cognitive and socioemotional benefits (Barac & Bialystok, 2012; Halle et al., 2014; Han, 2012), researchers have documented disparities in academic achievement between DLLs and their monolingual peers (Reardon & Galindo, 2009).

Research suggests that early social interactions, including with classmates, are one important factor that facilitates vocabulary development in both English and Spanish (Huttenlocher, Haight, Bryk, Seltzer, & Lyons, 1991; Palermo & Mikulski, 2013; Pearson, Fernandez, Lewedeg, & Oller, 1997). Yet, little research has examined how DLLs' peers may support DLL preschoolers' vocabulary development in English or Spanish. The purpose of this study is to examine the role of classmates' receptive vocabulary skills in predicting English and Spanish receptive vocabulary development between the fall and spring of preschool using a sample of DLLs attending Head Start.

1. Dual language learners in the United States

Children whose first language is not English represented 5 million students (10.1% of the school population) in the 2017–2018 school year (Hussar et al., 2020). The majority of these children identify as Hispanic or Latino and speak Spanish at home. Spanish-speaking Latino DLLs commonly come from families with low household income and have parents who have relatively few years of formal education (Calderón et al., 2011). Head Start is a particularly important early education context for such children living in poverty, and DLLs constitute a substantial proportion of Head Start attendees – more than a quarter (28%) of children enrolled in Head Start spoke a language other than English at home, and most of these children (80%) spoke Spanish (Administration for Children & Families [ACF], 2018). To better support the early development of DLLs from low-income families attending Head Start, it is therefore critical to examine how aspects of the classroom environment relate to DLLs' early vocabulary growth in English and Spanish.

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2. Dual language learners' early vocabulary development

Researchers and practitioners typically regard vocabulary development as a multidimensional system, in which the ability to comprehend words (receptive vocabulary) and the ability to produce words (expressive vocabulary) constitute distinct skills. Recent research, however, has empirically supported a unidimensional model of language development among preschoolers (Language & Reading Research Consortium [LARCC], 2015; Lonigan & Milburn, 2017; Tomblin & Zhang, 2006), in which lower level language skills, such as vocabulary, reflect one underlying trait. This research suggests that it is unnecessary and misleading to separately assess receptive and expressive vocabulary (LARCC, 2015). Researchers have also identified measurement issues with expressive vocabulary assessments among DLLs, observing substantial floor effects (Zhu & Gonzalez, 2017). For these reasons, the current study focuses on receptive vocabulary skill.

A critical question for researchers and practitioners is how to promote Spanish-speaking DLLs' English vocabulary skills, while supporting their Spanish vocabulary skills. Studies of vocabulary development among DLLs from low-income families have documented low average vocabulary skills overall in both languages (Hoff, 2013), particularly upon preschool entry (Hammer, Lawrence, & Miccio, 2008). However, there is substantial variability in DLLs' vocabulary skills in English and Spanish (López & Foster, 2021) and development in each language follows unique trajectories (Goodrich & Lonigan, 2018). Studies have found that DLLs who do not attain English proficiency by kindergarten or first grade may continue to lag behind their monolingual peers' long-term academic skill development (Halle, Hair, Wandner, McNamara, & Chien, 2012). At the same time, maintaining proficiency in Spanish holds notable benefits for children's cognitive skills (Barac & Bialystok, 2012; Yow & Li, 2015), connections to home communities (Wong Fillmore, 1991), and later economic success (Agirdag, 2014; Proctor, August, Carlo, & Barr, 2010; Rumbaut, 2014).

3. Social interactions and vocabulary development

This research draws on interactionist and social input theories of language development, which posit that language learning occurs through interactions within social environments (Lantolf & Thorne, 2006; Vygotsky, 1978) that facilitate opportunities for language usage (Tomasello, 2000). Accordingly, studies have found that children's vocabulary development is associated with the language used by social figures, such as parents (Hurtado, Marchman, & Fernald, 2008; Pearson et al., 1997) and teachers (Dickinson & Porche, 2011; Huttenlocher, Vasilyeva, Cymerman, & Levine, 2002). Through being exposed to language and engaging in language-rich interactions with these social figures, children are able to practice new words and constructions, thereby building their early vocabulary knowledge (De Houwer, 2007; Hammer et al., 2012). As children spend more time outside the home and in the classroom, social interactions with classmates become increasingly prevalent. Peers' vocabulary skills may thus influence individual preschool-aged children's vocabulary development through providing opportunities for children to directly interact with their peers, practice new words, and engage in sustained conversations (Chaparro-Moreno, Justice, Logan, Purtell, & Lin, 2019; Gámez, Griskell, Sobrevilla, & Vazquez, 2019). Peers' vocabulary skills may also indirectly influence individual children's vocabulary development if, for example, teachers provide higher quality language instruction in classrooms where children have higher vocabulary ability.

For DLLs, the relations between social interactions and vocabulary development are complex, since development in two languages is impacted by input in each language (Pearson et al., 1997). Given the importance of developing DLLs' skills in both English and Spanish (Callahan & Gándara, 2014), it is critical to understand how peers' vocabulary skills relate to DLL children's acquisition of vocabulary skills in both English and Spanish. This question has not been examined in the prior literature and is the focus of the current study.

4. Average peer effects and vocabulary development

Researchers typically estimate peer effects through analyzing the association between the average skills in a classroom and growth in individual students' skills (i.e., Hanushek, Kain, Markman, & Rivkin, 2003; Justice, Petscher, Schatschneider, & Mashburn, 2011). Most of the evidence examining links between peer ability and children's learning comes from studies among elementary and adolescent students' academic skill development (Boucher, Bramoullé, Djebbari, & Fortin, 2014; Hoxby, 2000; Neidell & Waldfogel, 2010). These studies have found significant, positive associations between classmates' ability levels and children's average reading and math achievement (Burke & Sass, 2013; Gottfried, 2014; Hanushek et al., 2003).

Among monolingual preschoolers, there is evidence that peers' vocabulary skills are related to vocabulary development (Chen, Justice, Tambyraja, & Sawyer, 2020; Henry & Rickman, 2007; Justice et al., 2011; Mashburn, Justice, Downer, & Pianta, 2009; Schechter & Bye, 2007). For example, two studies of monolingual English-speaking preschoolers from a range of socioeconomic backgrounds found that sharing classrooms with peers with higher mean vocabulary skills uniquely predicted English receptive and expressive vocabulary development, after accounting for initial vocabulary skills and a range of family, teacher, and school characteristics (Henry & Rickman, 2007; Mashburn et al., 2009). A similar study of low-income monolingual preschoolers found that children's English language growth was associated with the average language skills, including receptive and expressive vocabulary, of children in their classrooms (Justice et al., 2011).

Among DLLs, there is limited research about associations between average vocabulary skills in the classroom and DLLs' vocabulary development in English *and* Spanish. Atkins-Burnett et al. (2017) used a conceptual vocabulary measure – in which children are given credit for answering correctly in English or Spanish – and found that peers' bilingual expressive vocabulary skill positively predicted DLLs' total bilingual expressive vocabulary development. Since the conceptual measure combined English and Spanish vocabulary knowledge, however, this study did not examine language-specific associations between peers' vocabulary skill and DLL children's English and Spanish vocabulary. As a result, there is no extant research on the association between classmates' vocabulary skills and DLLs' unique English and Spanish vocabulary development.

Following research findings with monolingual preschoolers, sharing classrooms with peers who have stronger English vocabulary skills may promote DLLs' English vocabulary development. However, in classrooms with such peer groups, DLLs may also have limited opportunities to engage with peers in Spanish (Franco et al., 2019). Peers' stronger receptive vocabulary development may therefore come at a cost to DLLs' Spanish receptive vocabulary development. However, it is unclear from the current literature how classmates' skills may support or undermine the development of DLLs' Spanish vocabularies.

Together, findings from the literature on peer effects among English-speaking monolingual children suggest that children's classmates are one important avenue for supporting preschoolers' early academic skills generally, and vocabulary skills specifically, but the extent to which these findings generalize to low-income, DLL children's English and Spanish vocabulary development is unclear.

5. Variability of classmates' vocabulary ability

Some researchers have examined peer effects by measuring variability of skill levels within a classroom, or the standard deviation of classmates' skill levels (i.e., Atkins-Burnett, Xue, & Aikens, 2017; Finch, Garcia, Sulik, & Obradović, 2019). Less variability in a classroom's vocabulary skill may be beneficial for individual students' vocabulary development, if for example, teachers are better able to target their instruction to that level and support individual children's vocabulary development (Cho, 2012; Robinson, 2008). On the other hand, classrooms with higher variability may be beneficial for vocabulary skill development, since it may expose children to a range of skills and higher-level vocabulary skills. Such exposure may be particularly important for lower-ability children, and for DLLs who enter preschool with little prior exposure to English (Hammer et al., 2008).

Two studies that examined variability in elementary classmates' academic skills did not find evidence of an association with students' academic achievement growth (Burke & Sass, 2013; Hanushek et al., 2003). One study examined variation in DLL preschoolers' conceptually scored expressive vocabulary skills and similarly found null effects (Atkins-Burnett et al., 2017). However, the conceptually scored measure represented DLLs' total vocabulary knowledge, and the authors were unable to examine the association between variability in classmates' English skills and language-specific development in DLLs' English and Spanish vocabularies. Consequently, further studies examining how variability in peers' skills predict DLLs' English and Spanish receptive vocabulary development are warranted.

6. The proportion of DLLs in the classroom

The association between average vocabulary skills in the classroom and DLLs' vocabulary development in English or Spanish is complicated by the potential confound of the proportion of DLLs in the classroom. Since DLLs tend to enter preschool with lower English vocabularies, classrooms with more DLLs likely have lower average vocabulary skills. Some studies have found that higher proportions of DLLs are negatively associated with vocabulary development among DLL preschoolers (Ebert et al., 2013; Garcia, 2018), whereas others reported non-significant associations (Hindman & Wasik, 2015; Willard, Agache, & Leyendecker, 2019). Previous studies, however, have not considered both factors simultaneously. The current study thus contributes to the literature by holding constant the proportion of DLLs in the classroom, allowing an examination of whether peers' vocabulary skills are associated with DLLs' vocabulary development, independent of the classroom composition of DLLs.

In addition, associations between average levels of or variability in classmates' vocabulary skills and DLLs' English and Spanish receptive vocabulary skill development may vary depending on the proportion of DLLs in the classroom. In classrooms with higher proportions of English-speaking monolingual children, peers' English receptive vocabulary skills may be associated with DLLs' English receptive vocabulary development to a greater extent. At the same time, sharing classrooms with higher proportions of Spanish-speaking DLLs may attenuate any negative association between peers' English receptive vocabulary skills and DLLs' Spanish receptive vocabulary skills, since DLLs would, in theory, have more opportunities to engage with their peers in Spanish. However, prior research has not examined whether classroom-level factors such as the proportion of DLLs in the class moderate associations between peers' skills and the vocabulary development of preschool-aged DLLs.

7. The current study

This study examined peer effects on DLLs' English and Spanish receptive vocabulary development, among a sample of low-income children attending Head Start. To address three research questions, two measures of peer ability were used: average levels and variability. The research questions were as follows:

1 Do average levels and variability in peers' English receptive vocabulary skills predict Hispanic DLLs' year-end English receptive vocabulary skills?
2 Do average levels and variability of peers' English receptive vocabulary skill predict Hispanic DLLs' year-end Spanish receptive vocabulary skills?
3 Are the associations described in the first two research questions moderated by the proportion of DLLs in the classroom?

8. Method

8.1. Data

Data for this study were drawn from the 2009 cohort of the Head Start Family and Child Experiences Survey (FACES). The FACES study includes a nationally representative sample of 3- and 4-year-old children entering Head Start for the first time in the fall of 2009. Children in the FACES dataset were sampled in four steps. First, Head Start programs were stratified by census region, urbanicity, percentage of racial/ethnic minority enrollment, percentage of DLLs, and the percentage of children with disabilities. Second, Head Start centers were stratified by size and selected within programs. Third, classrooms were stratified by size and session length (i.e., full- or half-day), and were selected within centers. Finally, children were sampled within classrooms with equal probability of selection. The study was designed to sample 10 children per classroom, and after obtaining parental consent during a field site visit (90% consent rate), researchers obtained data on an average of eight children per classroom, ranging from one to 16. Further details on the sampling procedure can be found in the FACES User Guide (Malone et al., 2013).

8.2. Participants

The full FACES sample included 3349 students. The focus of this study and the main analyses were on Hispanic or Latino DLLs who spoke Spanish at home. However, to measure these DLLs' peer groups, children from DLLs' entire classrooms were included in the peer score, regardless of their home language status. The peer group sample was first restricted to include only children who had a valid English receptive vocabulary score in either the fall or spring, and second to children in classrooms with at least four valid receptive vocabulary scores total. The peer score was calculated for children in classrooms that met these criteria (for additional details, see the Measures section). The analysis sample was then restricted to: (1) children whose parents reported that they were Hispanic or Latino and spoke Spanish at home, (2) children with a valid Spanish receptive vocabulary score in either the fall or spring, and (3) children with non-missing teacher-reported data. These restrictions resulted in an analysis sample of 654 Spanish-speaking Hispanic DLLs nested within 182 classes and 75 Head Start centers.

The Spanish-speaking DLL children in the analysis sample were, on average, 46.4 months old ($SD = 6.25$) at the beginning of the school year. Most families in the analysis sample (72%) had incomes below the federal poverty line and 61% of mothers did not have a high school diploma. Just under half of teachers in the analysis sample (48%) held a BA or higher and nearly half of programs were full day (48%) as opposed to half-day.

8.3. Procedure

This study used data from a single year of Head Start, in the fall of 2009 and spring of 2010. Highly trained bilingual field assessors collected child assessment data. Children were administered assessments of receptive vocabulary in the fall and spring, as part of a larger battery of academic and social-emotional skills. Children who spoke Spanish in the home (according to parent interviews) received receptive vocabulary assessments in both English and Spanish.

In the fall and spring, Head Start lead teachers completed questionnaires about their own demographic information, and the characteristics of children in their classrooms. Parents were also interviewed in the fall and spring, responding to questions about their family demographics, including languages spoken at home, income, and educational attainment.

8.4. Measures

8.4.1. Vocabulary assessments

English receptive vocabulary was measured with the Peabody Picture Vocabulary Test – 4th Edition (PPVT-4; Dunn, Dunn, & Dunn, 2006). Spanish receptive vocabulary was measured with the Spanish version of the PPVT, the Test de Vocabulario Imágenes Peabody (TVIP; Dunn, Padilla, Lugo, & Dunn, 1986). Each assessment was administered in the fall of 2009 and spring of 2010. For both assessments, the child was shown a frame of four images while the assessor read a word aloud. The child was asked to point to the image that best represented the word. The test began based on the child's age and proceeded in difficulty until the child responded incorrectly to several items in a set.

The PPVT-4 is normed on a sample of English-speaking children and adults. The TVIP is normed on a sample of Spanish-speaking children in Mexico and Puerto Rico. For each assessment, raw scores were converted to standard scores based on the child's age, with a mean of 100 and a standard deviation of 15. Standard scores can thus be interpreted as relative to the child's same-age peers. Standard scores were used in the present analyses. The PPVT-4 is widely used and highly reliable, with publisher-reported internal consistency coefficients (alpha) of 0.96 and 0.97, and alternate form reliabilities ranging from 0.87 to 0.93. The TVIP reports an internal consistency coefficient of 0.93.

8.4.2. Peer vocabulary

Peer English receptive vocabulary was calculated as a leave-out mean and leave-out standard deviation. Leave-out peer scores are calculated at the child level rather than classroom level and take into account that a relatively high ability child has a different peer group than a relatively low ability child (Finch et al., 2019; Mashburn et al., 2009). The leave-out mean and standard deviation of peer scores were calculated using the English receptive vocabulary scores of each child in the classroom – both DLLs and non-DLLs – when there were valid scores for at least four or more children. This ensured that each child's peer estimate included no fewer than three peers, increasing the reliability of the estimate, and the percentage of the classroom included (Mashburn et al., 2009). The estimates of the mean and standard deviation of receptive peer ability included, on average, 7.6 children ($SD = 2.6$), ranging from four to 14 children. On average, a little under half of children in the classroom, 44.3% ($SD = 0.16$) were included in the peer measures, ranging from 20% to 93%, which is higher than the number of peers that have been included in prior studies of peer effects on preschoolers' vocabulary (e.g., Justice et al., 2011; Mashburn et al., 2009). Of children included in the estimate of peer ability, on average 3.8 ($SD = 2.6$) or 50.8%, ranging from one to 11 children, were Latino DLLs. DLLs who spoke languages other than

Spanish were included in the peer estimate, but there were few of them. Between one and five classrooms included one child each who spoke French, Hmong, or Arabic, and 27 classrooms included one to two children who spoke other languages (not specified in the FACES dataset).

Variables used as covariates included child and family characteristics and classroom and program characteristics. Parents reported on the characteristics of their children and families, including their years of educational attainment, and their child's age and gender. Mother's years of education were dichotomized to represent having a high school diploma or less, compared to some college or higher.

Teachers reported on their backgrounds and program characteristics, including their educational attainment, the number of children who were identified as DLLs, and the number of 3- and 4-year-olds in the class. Teacher education was dichotomized to represent having at least a BA or higher.

8.5. Analysis

Children in the FACES dataset were nested within classrooms and centers. To account for the complex error structure due to nesting, all data were analyzed using multilevel models within a Hierarchical Linear Modeling (HLM) framework (Raudenbush & Bryk, 2002). Analyses were conducted using two-level models that included a random intercept for the child's classroom. A two-level model rather than a three-level model was used because 32% of centers had only one classroom, and 34% had two classrooms. As a result, for many centers, classroom and center variance were equivalent.

Research Questions 1 and 2 use the following general two-level model:

$$y_{ij} = \beta_0 + \beta_1 Fall_{ij} + \beta_2 mean_{ij} + \beta_3 SD_{ij}$$
$$+ \beta_4 PDLL_j + \delta_{ij} + \mu_j + \lambda_j + \epsilon_{ij}$$

where y_{ij} represents the spring English or Spanish receptive vocabulary scores for child i in classroom j. The coefficient β_1 denotes the fall English or Spanish vocabulary score for child i in classroom j. The main coefficients of interest, β_2 and β_3, show the association between the mean and standard deviation of peers' receptive vocabulary skills and children's spring receptive vocabulary scores. The coefficient β_4 represents the proportion of DLLs in the classroom. In Model 1a, peers' mean vocabulary scores are entered alone; in Model 1b, the standard deviation of peers' vocabulary scores are entered in addition to the mean to control for the overall average vocabulary level in the classroom. Models 2a and 2b are the same as Models 1a and 1b, but predict Spanish receptive vocabulary development. Note that the mean and standard deviation of peer scores are at the individual child level, reflecting the leave-out mean and standard deviation.

The models for research question 3 are the same as those for research questions 1 and 2, with added interaction terms. Models 3a and 3b, and 4a and 4b included interaction terms between the proportion of DLLs (β_4) and peers' mean (β_2) and standard deviation vocabulary (β_3) vocabulary scores respectively.

All models include a vector of child- and family-level covariates, given by the term δ_{ij}, and a vector of classroom-level covariates for classroom j, denoted by the term μ_j. Finally, λ_j denotes the random effect for classrooms. All models also include sampling weights (PRA12WT) to account for the child's probability of selection, conditional on classroom and program selection.

8.5.1. Missing data

Between 0 and 9.9% of children in the analysis sample were missing English or Spanish vocabulary scores in the fall or spring,

Table 1
Descriptive statistics for all study variables.

	N	Mean or%	SD	Min	Max
Vocabulary scores					
Fall English receptive	589	61.74	19.72	20.00	120.00
Spring English receptive	601	71.15	15.43	27.00	122.00
Fall Spanish receptive	592	84.57	12.76	55.00	134.00
Spring Spanish receptive	623	84.49	14.93	55.00	145.00
Peer mean receptive	654	70.36	13.08	34.86	106.83
Peer SD receptive	654	19.01	6.61	1.73	44.81
Child characteristics					
Child age in months	654	46.37	6.25	33.00	59.00
Mother has some college or higher (%)	636	16.5			
Child is male (%)	654	49.5			
Classroom characteristics					
Teacher has BA or higher (%)	182	48.4			
Proportion of DLLs	182	0.53	0.33	0.05	1.00
Proportion of 3-year-olds	182	0.39	0.30	0.00	1.00

or data on family characteristics (Table 1). Children who were missing data differed from children with non-missing data in a few ways. Compared to children with complete fall English receptive vocabulary scores, children with missing scores had significantly lower English receptive vocabulary scores in the spring ($b = -8.45$, $P < 0.001$), and significantly lower Spanish receptive vocabulary scores in the fall ($b = -5.21$, $P < 0.05$). Children with missing spring receptive English vocabulary scores likewise had significantly lower fall English receptive vocabulary scores ($b = -14.4$, $P < 0.001$), and they were significantly younger ($b = -2.25$, $P < 0.01$) than children with complete English vocabulary scores in the spring. Finally, children missing maternal education data had significantly higher English receptive vocabulary scores in the spring ($b = 7.22$, $P < 0.05$). Data were multiply imputed using chained equations with the *mi* command in Stata 16, to compute 20 complete data files (Kontopantelis, White, Sperrin, & Buchan, 2017; Widaman, 2006).

9. Results

9.1. Descriptive statistics and bivariate correlations

Descriptive statistics for the analysis sample are presented in Table 1. Latino DLL children began the Head Start year with standard English receptive vocabulary scores ($M = 61.7$, $SD = 19.7$) over two standard deviations below the nationally normed mean, and Spanish receptive vocabulary scores ($M = 84.6$, $SD = 12.8$) one standard deviation below the nationally normed mean. These means are low but consistent with prior studies of low-income Spanish-speaking DLL children attending Head Start (Hammer, Lawrence, & Miccio, 2007), and reflect that many DLLs are exposed to English for the first time upon entering preschool.

Bivariate correlations (Table 2) show that DLLs' fall English receptive vocabulary scores were significantly and positively correlated with peers' mean English receptive vocabulary scores ($r = 0.20$, $P < 0.001$) and negatively correlated with variability in (standard deviation) of peers' English receptive vocabulary scores ($r = -0.09$, $P = 0.025$). These correlations indicate that children who had higher English receptive vocabulary scores were also more likely to share classrooms with peers who had higher mean English vocabulary skills, and less variability in English vocabulary skills. However, DLLs' fall Spanish receptive vocabulary scores were not significantly correlated with peers' mean English receptive vocabulary scores or variability in peers' English receptive vocabulary scores.

9.2. Mean and variability in peers' English vocabulary skills and DLLs' vocabulary growth

The first research question was whether the mean and variability in English receptive vocabulary skill were associated with DLLs' English receptive vocabulary scores in the spring. Model 1a shows that peers' average English receptive vocabulary skills were significantly and positively associated with DLLs' English receptive vocabulary scores in the spring ($b = 0.101$, $P = 0.007$), net of children's fall vocabulary skill, and other family and classroom characteristics (Table 3). In Model 1b, variability in peers' vocabulary skill was added to the model with average peer ability. Variability in peers' English receptive vocabulary skill did not significantly predict DLLs' English vocabulary skill in the spring ($b = 0.034$, $P = 0.65$). Peers' average vocabulary skill, however, persisted in predicting spring English vocabulary scores with the standard deviation of peers' skills included in the model ($b = 0.107$, $P = 0.009$).

Research Question 2 was whether average scores and variability in peers' English receptive vocabulary skills were associated with DLLs' Spanish receptive vocabulary scores in the spring. Model 2a (Table 3) shows that peers' average English receptive vocabulary ability was significantly and negatively associated with spring Spanish vocabulary scores ($b = -0.111$, $P = 0.02$). Model 2b shows that variability in peers' English receptive vocabulary was not significantly associated with DLLs' Spanish vocabulary scores in the spring ($b = -0.003$, $P = 0.97$). Peers' average English vocabulary skills significantly and negatively predicted DLLs' spring Spanish vocabulary skill in the variability model ($b = -112$, $P = 0.02$).

9.3. Moderation by the proportion of DLLs in the classroom

Research Question 3 was whether the association between peers' average levels (Models 3a and 4a) and standard deviation (Models 3b and 4b) of vocabulary and DLLs' spring vocabulary scores in English and Spanish was moderated by the proportion of DLLs in the classroom (Table 4). As shown in Model 3a, the interaction between peers' average English vocabulary skills and the proportion of DLLs was not statistically significant for their spring English receptive vocabulary skills ($b = -0.102$, $P = 0.35$). As shown in Model 3b, the interaction between the standard deviation of peers' English vocabulary skills and the proportion of DLLs ($b = -0.030$, $P = 0.90$) was similarly not statistically significant.

Model 4a shows that the interaction between peers' average English vocabulary skills and the proportion of DLLs in the classroom was not statistically significant ($b = -0.047$, $P = 0.71$) for DLL's spring Spanish receptive vocabulary skills. Similarly, Model 4b shows that the interaction between the standard deviation of

Table 2
Bivariate correlations for all study variables.

	(1) Fall English	(2) Spring English	(3) Fall Spanish	(4) Spring Spanish	(5) Mean peer	(6) SD peer	(7) Child age	(8) Mother college+	(9) Child male	(10) Prop. DLL	(11) Prop. 3 y.o.
1. Fall English receptive	–										
2. Spring English receptive	0.72***	–									
3. Fall Spanish receptive	0.11**	0.14***	–								
4. Spring Spanish receptive	0.03	0.11**	0.55***	–							
5. Mean peers' receptive	0.20***	0.23***	−0.02	−0.11**	–						
6. SD peers' receptive	−0.09*	−0.05	−0.05	0.04	−0.27***	–					
7. Child age in months	−0.04	−0.00	−0.29***	−0.09*	−0.06	0.13***	–				
8. Mother has some college+	0.15***	0.13**	0.09*	0.10*	0.02	0.04	−0.04	–			
9. Child is male	−0.01	−0.01	−0.06	−0.10*	−0.00	−0.04	0.09*	0.06	–		
10. Proportion DLLs	−0.04	−0.11**	0.02	0.03	−0.40***	−0.06	0.01	−0.02	−0.04	–	
11. Proportion 3-year-olds	0.03	−0.01	0.14***	−0.01	0.03	−0.15***	−0.51***	0.00	0.02	−0.02	–
12. Teacher has BA or higher	−0.02	0.02	−0.08*	0.03	−0.05	0.04	0.14***	−0.10*	0.02	−0.07	−0.07

Notes: $N = 654$.
* $P < 0.05$.
** $P < 0.01$.
*** $P < 0.001$.

peers' English vocabulary skills and the proportion of DLLs, was not statistically significant ($b = -0.229$, $P = 0.35$).

10. Discussion

This study examined the role of classmates' vocabulary skills in predicting low-income DLLs' English and Spanish receptive vocabulary development during preschool. Classmates' skill levels are a key aspect of children's classroom experiences when they enter preschool and spend increasingly more time with peers (Henry & Rickman, 2007; Justice et al., 2011; Mashburn et al., 2009). Understanding predictors of English and Spanish receptive vocabulary development is particularly important among low-income DLLs, many of whom experience little English exposure prior to entering center-based schooling (Hammer et al., 2008), but who may benefit from maintaining their Spanish language skills (Agirdag, 2014; Barac & Bialystok, 2012). This study's findings corroborated the only prior study of peer effects among DLL preschoolers (Atkins-Burnett et al., 2017), as well as the broader peer effects literature (e.g., Hanushek et al., 2003). Results pointed to a tension between promoting English vocabulary skills while maintaining Spanish vocabulary: DLLs whose classmates had higher average English receptive vocabulary skills had higher English receptive vocabulary skills, but lower Spanish receptive vocabulary skills in the spring. Variability in peers' English receptive vocabulary scores, however, was not associated with DLLs' spring receptive vocabulary scores in English or Spanish. These associations did not depend on the proportion of DLLs in the classroom.

10.1. Peers' average vocabulary skills and DLLs' vocabulary growth in English and Spanish

The DLLs in the current study had higher English receptive vocabulary skills when their classmates had higher average English receptive vocabulary skills. These findings are consistent with studies of monolingual, English-speaking preschoolers (Henry & Rickman, 2007; Justice et al., 2011; Mashburn et al., 2009). On the other hand, DLLs whose classmates had better English receptive vocabulary skills also had lower Spanish receptive vocabulary skills in the spring. Together, these findings suggest that though peers with stronger English skills may be an important resource for promoting Spanish-speaking DLLs' English vocabulary skill, such gains in English skills may be offset by losses in Spanish skills.

This pattern is concerning since bilingualism confers a range of advantages upon children throughout their development and into adulthood; research shows that "balanced bilinguals" who have maintained their first language skills while acquiring a second language attain better developmental and economic outcomes (Agirdag, 2014; Han, 2010, 2012; Yow & Li, 2015). For this reason, guidance from organizations such as the National Association for the Education of Young Children (2009) and the National Academies of Sciences (2017), as well as Head Start's Program and Performance Standards (ACF, 2016) recommend supporting DLL children's first language as one way of promoting development in their second language. Consequently, though practitioners may wish to capitalize upon children's English-speaking peers to promote English vocabulary development, care must be taken to support Spanish vocabulary skills at the same time. This could entail purposeful incorporation of Spanish language interactions into classroom activities, between teachers and DLLs and among DLL peers.

Notably, these associations held while controlling the proportion of DLLs. Moreover, these patterns did not vary by the proportion of DLLs in the classroom, suggesting that having more or fewer DLLs with whom to interact does not change the degree to which peers' English receptive vocabulary skills are pos-

Table 3

Multilevel regression models predicting English and Spanish receptive vocabulary scores from mean and SD peer English receptive vocabulary.

| Fixed effects | Spring English receptive vocabulary | | | | Spring Spanish receptive vocabulary | | | |
| | Model 1a: Mean | | Model 1b: SD | | Model 2a: Mean | | Model 2b: SD | |
	b	(SE)	b	(SE)	b	(SE)	b	(SE)
Mean peer vocabulary	0.10**	(0.04)	0.11**	(0.04)	−0.11*	(0.05)	−0.11*	(0.05)
SD peer vocabulary			0.03	(0.07)			−0.00	(0.09)
Proportion of DLLs	−1.40	(1.73)	−1.27	(1.77)	−0.07	(1.66)	−0.09	(1.68)
Fall English rec. vocabulary	0.55***	(0.02)	0.55***	(0.02)	0.67***	(0.04)	0.67***	(0.04)
Age in months	0.01	(0.07)	0.01	(0.07)	0.09	(0.10)	0.09	(0.10)
Maternal education	0.58	(1.15)	0.54	(1.16)	2.08	(1.31)	2.09	(1.30)
Male	−0.15	(0.81)	−0.13	(0.81)	−1.73+	(1.04)	−1.73+	(1.04)
Proportion of 3 year-olds	−1.64	(1.63)	−1.56	(1.63)	−2.73	(1.85)	−2.73	(1.85)
Teacher has BA or higher	0.99	(1.02)	0.99	(1.02)	1.79	(1.11)	1.79	(1.11)
Intercept	29.61***	(2.97)	28.54***	(3.95)	35.64***	(4.78)	35.75***	(5.64)
Random effects								
Classroom intercept variance	1.07***	(0.28)	1.03**	(0.33)	0.62	(2.57)	0.64	(1.46)
Residual variance	2.30***	(0.04)	2.30***	(0.04)	2.49***	(0.04)	2.49***	(0.04)

SD = standard deviation.

Note: N = 654. Standard errors in parentheses. Dependent variables in column headers. All continuous variables are grand mean centered. Model includes random intercept on classrooms, and sampling weights to account for the probability of selection. Multiply imputed on 20 datasets.

* *P* < 0.05.

** *P* < 0.01.

*** *P* < 0.001.

Table 4

Multilevel regression models predicting English and Spanish receptive vocabulary scores with mean and SD peer receptive vocabulary interacted with the proportion of DLLs.

| Fixed effects | English receptive vocabulary | | | | Spanish receptive vocabulary | | | |
| | Model 3a: Mean X Prop. DLLs | | Model 3b: SD X Prop. DLLs | | Model 4a: Mean X Prop. DLLs | | Model 4b: SD X Prop. DLLs | |
	b	(SE)	b	(SE)	b	(SE)	b	(SE)
Mean peer vocabulary	0.10*	(0.04)	0.11**	(0.04)	−0.11*	(0.05)	−0.11*	(0.05)
SD peer vocabulary			0.03	(0.07)			−0.01	(0.08)
Proportion of DLLs	−1.31	(1.71)	−1.29	(1.78)	−0.07	(1.64)	−0.11	(1.71)
Mean peer X prop. DLLs	−0.10	(0.11)			−0.05	(0.13)		
SD peer X prop. DLLs			−0.03	(0.24)			−0.23	(0.25)
Fall Spanish rec. vocabulary	0.55***	(0.02)	0.55***	(0.02)	0.67***	(0.04)	0.67***	(0.04)
Age in months	0.01	(0.07)	0.01	(0.07)	0.09	(0.10)	0.10	(0.10)
Maternal education	0.62	(1.15)	0.53	(1.15)	2.11	(1.30)	2.02	(1.29)
Male	−0.18	(0.81)	−0.12	(0.80)	−1.74+	(1.04)	−1.67	(1.04)
Proportion of 3-year-olds	−1.35	(1.65)	−1.58	(1.63)	−2.60	(1.90)	−2.89	(1.88)
Teacher has BA or higher	0.94	(1.03)	1.00	(1.00)	1.76	(1.11)	1.86+	(1.11)
Intercept	29.84***	(2.98)	28.51***	(3.97)	35.77***	(4.77)	35.35***	(5.69)
Random effects								
Classroom intercept variance	1.08***	(0.28)	1.03**	(0.33)	0.04	(6.37)	0.69	(0.95)
Residual variance	2.30***	(0.04)	2.30***	(0.04)	2.49***	(0.04)	2.49***	(0.04)

Prop = proportion; SD = standard deviation.

Note: N = 654. Standard errors in parentheses. Dependent variables in column headers. All continuous variables are grand mean centered. Model includes random intercept on classrooms, and sampling weights to account for the probability of selection. Multiply imputed on 20 datasets.

* *P* < 0.05.

** *P* < 0.01.

*** *P* < 0.001.

itively and negatively associated with DLLs' English and Spanish receptive vocabulary skills respectively. Other studies have found that classroom composition of language background and age are important predictors of children's outcomes, including vocabulary (Ansari, Purtell, & Gershoff, 2016; Cho, 2012; Garcia, 2018) . The current findings point to the utility of understanding the role of classmates' English skill levels, beyond the concentration of students' characteristics.

10.2. Understanding associations between classmates' average English vocabulary skills and DLLs' vocabulary growth

This study was not able to examine the mechanisms driving these associations between classmates' average English receptive vocabulary skills and DLLs' receptive vocabulary growth in English and Spanish. The findings may reflect direct interactions be-

tween students, teachers' instructional practices, or a combination of these factors. Below, I discuss these potential mechanisms. Few studies have examined these factors and they would be fruitful areas for future research.

10.2.1. Student interactions

First, peer effects on DLLs' English and Spanish receptive vocabulary skills may operate through direct interactions between students. Having classmates with stronger English receptive vocabulary skills may have promoted DLLs' English receptive vocabulary development because children with higher vocabulary skills acted as peer mentors to children with weaker vocabulary skills. One recent study directly tested this mechanism and found that engaging in more intensive language-rich interactions with peers was related to language growth for children with disabilities (Chen et al., 2020). Other studies have found that DLL children's English vo-

cabularies benefit from directly engaging with their peers in English (Palermo & Mikulski, 2013). In addition, one intervention study found that elementary-aged DLL children's receptive vocabulary development increased as a result of participating in cross-age peer interactions in which older and more skilled peers helped scaffold younger children's vocabulary knowledge during play and group work (Silverman et al., 2017).

The negative association between peers' English receptive vocabulary skills and DLLs' Spanish receptive vocabulary development may have occurred because there were fewer opportunities for DLLs to speak Spanish with their peers. In classrooms with higher average English vocabulary skills, DLLs may prefer to speak English, limiting opportunities for DLLs to hear and practice Spanish vocabulary with their peers. Supporting this interpretation, studies examining DLL preschoolers' linguistic interactions have found that children engage in very few Spanish language interactions with their DLL peers (Franco et al., 2019; Sawyer et al., 2018).

10.2.2. Teachers' instructional practices

Second, the associations found in the current study may be driven indirectly by teachers' practices, including the language of instruction. In classes with stronger average English vocabulary skills, teachers may have used English only with children instead of Spanish in addition to English. Prior research has found that using both English and Spanish in preschool classrooms is associated with maintaining or developing DLLs' Spanish receptive vocabulary skills (Durán, Roseth, Hoffman, & Robertshaw, 2013; Garcia, 2018; Raikes et al., 2019). However, studies have also found that even in classrooms with at least one Spanish-speaking teacher serving primarily DLLs, children were exposed to very little Spanish language from teachers, and most of that language was focused on routines or behavioral corrections (Franco et al., 2019). It is possible that this pattern is true to a greater extent in classrooms where students have higher average English vocabulary skills, which would leave children in such classrooms with scarce opportunities to hear novel and more complex words in Spanish. Given the robust research evidence on the importance of Spanish instruction, as well as guidance from Head Start and other professional communities, it is critical for teachers to purposefully integrate Spanish language interactions into their classroom practice with DLLs regardless of the average English vocabulary skills of DLLs in the class.

Finally, it is possible that when teachers have children in their classrooms with higher average English vocabulary skills, they may increase the academic level of their English instruction, providing DLLs with more opportunities to engage with complex words. This could result in greater exposure to higher-level words in English, which has been shown to predict preschoolers' receptive vocabulary development (Dickinson & Porche, 2011). At the same time, if teachers used higher-level English vocabulary words more frequently, they perhaps did not supplement this practice with the use of "academic" Spanish words. However, one study found that peer effects on preschoolers' language development were not mediated by teachers' instructional practices (Yeomans-Maldonado, Justice, & Logan, 2017), suggesting that teachers do not alter their instruction in response to the language skill level of the classroom. Nevertheless, in addition to purposefully engaging with DLLs in more high-quality, Spanish language interactions, teachers should provide resources such as small group supports and translated materials to ensure that DLLs receive high quality of instruction in Spanish in addition to English.

10.3. Variability in peers' English receptive vocabulary skills

Variability in classmates' English receptive vocabulary skill was not significantly associated with DLLs' overall English or Spanish receptive vocabulary growth. This finding is consistent with prior studies that have also found null effects associated with the standard deviation of classroom skill levels (Atkins-Burnett et al., 2017; Hanushek et al., 2003).

This consistent lack of an association between variability in peers' skills and individual children's growth may be explained by low overall variability in classmates' skills. Tracking students by ability level is commonplace across the elementary, middle, and high school grades (Betts, 2011), and even in preschool, subsidized centers like Head Start de-facto track students from low-income families who, on average, have lower academic abilities together (Justice et al., 2011). Therefore, even in preschool classrooms with relatively greater variability, low overall variability may limit children's opportunities to engage with peers with a range of vocabulary skill levels.

Sustained interactions between peers are hypothesized to be one way in which children's classmates' skill levels may influence individual children's language skill development (Chaparro-Moreno et al., 2019; Chen et al., 2020; Franco et al., 2019). It is possible that the low overall variability in classmates' skills precluded these interactions from occurring (Sawyer et al., 2018). More detailed observational studies that examine children's interactions with peers of different skill levels are needed to better understand this issue.

It is also possible that teachers do not implement instructional practices that are responsive to different degrees of variability in children's skills and that could relate to children's vocabulary development. Instructional practices could include, for example, mixed-ability groupings, and of relatively low-ability students working with more advanced peers (Burris, Heubert, & Levin, 2006; Park & Lee, 2015; Schechter & Bye, 2007). Intentionally implementing such instructional strategies could result in stronger vocabulary development for DLLs whose classmates' vocabulary skills vary more widely.

10.4. Implications for preschools and teachers

This study has important implications for how DLL children from low-income families are distributed among preschool centers and in classrooms. For practitioners, the findings point to a challenging tension of creating classroom peer environments that promote DLLs' English development while supporting the maintenance of their home language. The current findings suggest that DLLs need access to peers with higher average levels of English receptive vocabulary skills, as well as additional supports to maintain their Spanish vocabulary skills. However, the optimal balance of DLLs and ability levels within a classroom is not clear from the literature, nor is it easy to accomplish. Nevertheless, the current study's findings demonstrate that it is important for policy-makers and preschool administrators working with linguistically diverse communities to carefully and intentionally consider how to configure classroom assignment of children so that children from low-income families can have access to peers who can help support their English and Spanish vocabulary development.

Furthermore, teachers could work to incorporate small group work that facilitates peer interactions. Small group work with peers may be beneficial in and of itself (Gillies, 2003), and children with low vocabularies in small mixed-ability groups in particular might experience significant learning gains (Park & Lee, 2015). These kinds of small-group interactions may allow DLLs to practice Spanish or other home languages with one another, and for teachers to incorporate Spanish-language instruction. Teachers and other staff working in preschool classrooms should provide additional Spanish language resources like books, posters, and signs (Goldenberg, Hicks, & Lit, 2013) to help DLLs learn Spanish vocabulary along with English vocabulary.

10.5. Strengths, limitations, and future directions

A strength of this study is its relatively large, nationally representative sample of preschool-aged DLLs attending Head Start. The primary limitation of this study is that it is observational and therefore cannot be used to infer that the peer effects observed are causal. In addition, findings that children in the analytic sample with missing data differed on some characteristics limit this study's ability to generalize to other samples of low-income DLLs attending Head Start.

Another strength of the study is that it included a relatively large proportion of the students in classrooms to estimate peer ability. However, in most cases the peer vocabulary measure did not include the full classroom. Although exclusion criteria were intended to increase the reliability of the estimates of peer ability, research that includes data on the entire classroom is necessary to gain a better estimate of peer effects. In addition, there were not enough Spanish-speaking DLLs to estimate a measure of peers' Spanish vocabulary. One interesting future direction would be to examine whether peers' Spanish abilities contribute to DLLs' Spanish language development; studies examining language interactions among DLLs, their peers, and teachers in both English and Spanish would be particularly informative. Further, this study examined English and Spanish receptive vocabulary development separately, but future research should consider DLLs' bilingual profiles, characterizing how the two languages develop in concert. Recent studies have implemented latent profile analysis to understand the balance of DLLs' skills in the first and second languages (López & Foster, 2021). An important extension of this work is to examine how associations between classroom factors, such as peers' skill levels, and DLLs' vocabulary skills depend on the balance of DLLs' language skills in their first and second languages. Similarly, there is scant research that examines variability within DLLs' experiences, including how the home and classroom language environments together relate to DLLs' language development. Research that takes the interplay between both settings into account is needed.

Finally, while this study focused on a key developmental milestone for DLL preschoolers in two languages, vocabulary is only one dimension of children's language development. Studies among preschoolers examining other elements of language and preliteracy skills are scarce (Justice et al., 2011), and future research should examine how peers' language abilities are related to other dimensions of children's language development.

11. Conclusions

The current study demonstrates that sharing classrooms with peers who have relatively strong English vocabularies can promote preschool-aged DLLs' English receptive vocabulary skill. However, peers' higher average English vocabulary skills may come at a cost to DLLs' Spanish vocabulary development. These patterns were not explained by nor were they moderated by having peers who were English monolingual or DLLs. These findings indicate that teachers and preschool administrators could leverage variation in children's ability levels through creating mixed-language-ability classrooms, and opportunities for peer-to-peer interactions to help support children's vocabulary knowledge; these opportunities should include enhanced supports for Spanish vocabulary.

Author contribution

Elisa B. Garcia: Conceptualization, Formal Analysis, Data Curation, Methodology, Writing – Original Draft, Writing – Review and Editing.

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