



Exploring the mechanism through which peer effects operate in preschool classrooms to influence language growth



Jing Chen^{a,*}, Laura M. Justice^a, Sherine R. Tambyraja^a, Brook Sawyer^b

^a The Ohio State University, United States

^b Lehigh University, United States

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ABSTRACT

Peer-effects research finds that preschool children's language growth is associated with classmates' skills and that children with disabilities especially benefit from classmates with higher skills. The current study estimates the amount of *peer language resources* individual children access through their classroom-based peer social interactions, which represents an aggregation of peers' language skills weighted by teacher-perceived interaction intensities between dyads. Participants were 448 children (57% boys, 40% with disabilities, $M_{\text{age}} = 52.29$ months) from 58 inclusive preschool classrooms. Results showed a significant variation of peer language resources within classrooms and indicated that children with disabilities had significantly fewer peer language resources, although peer language resources showed a stronger association with their language growth than that of typically developing children.

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1. Introduction

More than one-half of American 3- to 5-year-old children participate in center-based preschool programming in the years prior to kindergarten (Kena et al., 2016); this programming provides important opportunities for children to socialize with one another in peer interactions, including play (Coplan & Arbeau, 2009, p. 144). During the preschool period, children's play becomes increasingly social, moving from the solitary and parallel play to a more interactive experience directly involving peers (Parten, 1932; Rubin, Watson, & Jambor, 1978). Regardless of the complexity of peer interactions, this tendency of interacting with peers seems to increase the potential direct influence of peers on individual children's development of language skill, which has been referred to as "peer effects" in the literature (e.g., Justice, Petscher, Schatschneider, & Mashburn, 2011; Mashburn, Justice, Downer, & Pianta, 2009; Ribeiro, Zachrisson, & Dearing, 2017). These studies show that children's language growth in preschool classrooms is directly associated with their classmates' language abilities, a phenomenon that appears particularly important for children with lower levels of language skill, such as children with disabilities (Justice, Logan, Lin, & Kaderavek, 2014). This work indicates that children with lower levels of language skill particularly benefit from having more highly

skilled classmates, presumably because the former group of children has the opportunity to be exposed to more complex linguistic input during peer interactions in the classroom. Recent research also shows that these peer effects operate independently of teachers' instructional quality, thus offering a unique source of influence on young children's language development in preschool settings (Yeomans-Maldonado, Justice, & Logan, 2017).

The present study contributes to the emerging literature on peer effects in preschool settings as the first to take into account the intensity, or the amount, of peer social interactions between a given child and each of her classmates when modeling peer effects. This study addresses a key limitation of the extant work on preschool peer effects, namely that most studies conceptually treat peer effects as a classroom characteristic, while the amount of language resources each child can access through peer interactions likely varies substantially across children based on with whom they most frequently interact. Such individual differences can be especially salient in preschool inclusive classrooms, where children with disabilities prefer to interact with peers who also have disabilities, and children without disabilities tend to interact with other children without disabilities (e.g., Chen, Justice, Rhoad-Drogalis, Lin, & Sawyer, 2018; Chen, Lin, Justice, & Sawyer, 2017). Given that children with disabilities tend to have lower language skills than children without disabilities, this circumstance may limit the availability of sophisticated linguistic input from peers, and, therefore, moderate the effects of peers on language growth for children with disabilities. In this study, we refer to the construct, *peer language*

* Corresponding author.

E-mail address: chen.4046@osu.edu (J. Chen).

resources, to represent the phenomenon whereby peer language skills serve as a potential resource to a child when that peer is a frequent interactive partner in the classroom. The current study aims to examine the availability of peer language resources at an individual child level within the preschool classroom for preschoolers with and without disabilities, and to explore the extent to which peer language resources are associated with language growth for typically developing children and those with disabilities.

1.1. Peer effects and early language development

Peer effects refer to the phenomenon characterizing peers as influential to an individual's development (e.g., Mashburn et al., 2009), which in the present study concerns the effects of preschool children on each other within center-based early-education classrooms. In this context, peer effects can be interpreted through the lens of social learning theory (Bandura, 1971) and sociocultural theory (Vygotsky, 1979). Bandura proposed that the key mechanisms through which children learn from peers are observation and imitation; Vygotsky suggested that learning and development occur during social activities, through which individuals construct and deepen their understandings on top of each other. In addition, from an ecological perspective (Bronfenbrenner & Morris, 1998; Zigler & Bishop-Josef, 2006), children's development is a product of interactions between children and layers of environment, where the most proximal environment in the classroom is constructed by peers. Collectively, these developmental theories situate peers as important resources for young children's development.

Peer social interactions, or social play, are believed to be beneficial for young children as they provide a key mechanism through which children develop language, cognitive, and social skills, as they learn to modify, monitor, and evaluate their emotions, and develop their divergent thinking skills via exposure to multiple perspectives from different peers (e.g., Bulotsky-Shearer, Bell, Romero, & Carter, 2012; Coplan & Arbeau, 2009). Among the broad range of potential developmental benefits of peer social interactions, the current study focuses specifically on peer effects in relation to young children's language development, as language acquisition is conditioned on social interactions with others (Huttenlocher, Vasilyeva, Cymerman, & Levine, 2002). That is, language acquisition relies on linguistic input provided within the child's developmental context comprising parents, teachers, and peers (Mashburn et al., 2009).

Traditionally, researchers have most extensively studied children's exposure to linguistic input from parents and teachers (e.g., Hart & Risley, 1995; Huttenlocher et al., 2002). However, recent studies increasingly emphasize the importance of studying linguistic input from peers, since preschool children spend a significant amount of time interacting with their peers within the classroom context (Fuligni, Howes, Huang, Hong, & Lara-Cinisomo, 2012). Researchers assert that peer social interactions usually involve discussions, negotiations, conflict resolutions, and the establishment of roles and rules, which provide important opportunities for the development of language and communication skills (Andresen, 2005; Coplan & Arbeau, 2009). Although peer social interactions may occur in different formats (e.g., complex sociodramatic play or brief utterances), which vary in terms of the complexity of the activity, they provide children with opportunities to practice their developing language skills in a social context. In addition, these communicative exchanges expose children to peer language that is contingent on the child's own use of language, as in the case when a peer responds to a child's question or builds upon an ongoing topic of discussion. Such contingency is crucial for language development, whether provided by an adult or a peer (e.g., Lucas, Villegas, & Freedson-Gonzalez, 2008; Tamis-LeMonda, Kuchirko, & Song, 2014). However, the contingencies provided within peer-to-peer

talk might have particular developmental salience due to children's similarities in abilities, which may allow children to learn more efficiently from peers than from adults (Tudge & Rogoff, 1999).

1.2. Individual differences in peer language resources

In the current study, we modeled peer effects as a function of the language skills of those peers with whom a given child most frequently interacts, which we refer to as peer language resources. This construct reflects the amount of language resources to which a child has access through their social interactions with peers in the preschool classroom. Among the existing studies focused on the effects of peers' language ability on individual children's language growth, these tend to treat a child's exposure to peers as a fixed characteristic, corresponding to the average language ability of the children in the classroom (e.g., Justice et al., 2011, 2014). Although Mashburn et al. (2009) operationalized this "peer effect" at the child level, by removing the ability of an individual child when calculating the classroom-mean language ability for the child, they still conceptualized peer effect as the average level of language skill in the classroom. However, there could be significant individual differences in the amount of language resources that children can assess through their interactions with peers, as we further elaborate.

First, not all children in a classroom engage in peer social interactions to the same extent. Coplan and Arbeau (2009) suggested that although children's play becomes more social between age three and five years, solitary and parallel play may still be the norm for some children at these ages, especially for children with social anxiety, low-self-esteem, or low social skills. Likewise, children with impaired language skills tend to have fewer interactive partners in the classroom (Chen et al., 2018), while children with better language abilities tend to interact more often with peers (e.g., Dionne, Tremblay, Boivin, Laplante, & Perusse, 2003; Mendez & Fogle, 2002). Therefore, it is necessary to take into account the intensity of interaction for each child when constructing peer language resources.

Second, there are individual differences among children in their choices for social interaction partners. A well-established individual difference in peer social interactions is the homophily effect (McPherson, Smith-Lovin, & Cook, 2001), which refers to the phenomenon whereby individuals are more likely to interact with others who exhibit similar characteristics. One of the most widely documented examples in the literature is the gender homophily effect, such that across various cultural contexts, as early as three years old, children tend to play with peers of the same gender (e.g., Fabes, Hanish, & Martin, 2003; Munroe & Romney, 2006). The homophily effect of ability has also been reported in the literature. Lin, Justice, Paul, and Mashburn (2016) showed that preschool children tended to interact more often with peers with similar language and literacy skills, after controlling for the gender homophily effect. Moreover, several recent studies also report a disability homophily effect in inclusive preschool classrooms (Chen et al., 2018; Chen et al., 2017; Lin, Chen, Justice, & Sawyer, 2019). Hence, even within the same classroom, children may access different amounts of language resources through their peer social interactions, as individuals choose to interact with different peers who vary in their linguistic abilities. Therefore, when examining the amount of language resources children assess through peer social interactions, peers' language abilities need to be taken into account.

1.3. Children with disabilities in preschool classrooms

Participation in preschool programming provides an important opportunity for young children with disabilities to engage in learning activities with typically developing peers and potentially harness the peer effects operating in these settings. Approximately

ten percent of children in the public schools have an identified disability (U.S. Department of Education, 2012), and federal legislation requires that children with disabilities be educated alongside typically developing children to the extent possible, in what is referred to as the least restrictive environment (LRE) and inclusive education (Individuals With Disabilities Education Act, 2004). For preschool-aged children, inclusive practices may involve placing one or several children with disabilities in a classroom serving a general population of children or creating special classrooms that serve a larger number of children with disabilities (e.g., 6–8) alongside a similar number of typically developing peers. Both models stand in contrast to self-contained programming, in which a classroom exclusively serves children with disabilities. Regardless of the particular inclusive practice employed, the impetus for such programming is that children with disabilities will be positively influenced by their interactions with typically developing peers, which may serve to stimulate cognitive, linguistic, and social development as informed by social learning theory (Bandura, 1971).

Nonetheless, even in inclusive classroom settings, it is not entirely clear whether young children with disabilities frequently interact with typically developing peers. In one recent study of 485 preschool-aged children in 64 preschool special education classrooms, Chen et al. (2017) found that children with disabilities were less likely to experience play interactions with classmates compared to their typically developing classmates, although they were comparable in their conflict interactions. In a subsequent study focused specifically on children with developmental language disorder (DLD), one of the most prevalent types of early childhood disability, Chen et al. (2018) reported that children with DLD interacted with significantly fewer playmates and were more likely to be isolated in the classroom than their typically developing peers. Additionally, they found that these unfavorable experiences of children with DLD were above and beyond the effects of their social-pragmatic skills. Taken together, these studies suggest that children with disabilities are likely to have constrained access to peer language resources given that they engage in limited social interactions, particularly with typically developing peers who likely have stronger language abilities.

1.4. The current study

The current study is based on the premise that peer social interactions serve as a key resource for children's language development and that there may be significant individual differences among children in the extent to which they experience these peer social interactions. To this end, this study examined the association between peer language resources, representing the amount of peer language resources to which a given child has access through peer social interactions, and individual children's gains in language ability over the course of one academic year. Extending the literature on peer effects on preschool children's language growth, the current study takes into account individual differences in the extent to which children interact with different classmates who vary in their language skills. In addition, the current study aims to examine the differential effect of peer language resources on children with disabilities versus typically developing children within preschool inclusive classrooms.

When operationalizing peer language resources, children's interaction intensity with each classmate and each classmate's language abilities need to be taken into account. As elaborated in the method section, peer language resources are operationalized as the weighted sum of the language abilities of a child's classmates, where the weights are the interaction intensity between the child and each of his classmates. To examine a child's interaction intensity with each classmate, we utilized a teacher-report approach whereby teachers rated the extent to which every pair of

children in their classroom play with each other on a typical school day over a three-month period. Alternative approaches to assessing interaction intensity include children's self-report via peer nomination as well as researchers' direct observations, both of which have been used in the preschool context (e.g., Daniel, Santos, Antunes, Fernandes, & Vaughn, 2016; Martin & Fabes, 2001). However, researchers have discussed that the teacher-report approach might generate more reliable information than self-report from young children or children with disabilities (Lin et al., 2016; Robertson, Chamberlain, & Kasari, 2003; Shin, Kim, Goetz, & Vaughn, 2014). In addition, although teacher report and researcher observations may be congruent in capturing classroom peer-social interactions (Gest, Farmer, Cairns, & Xie, 2003), compared with researcher observations within specific time windows, teachers can comprehensively take into account peer-social interactions across settings through their ongoing observations (Cabell, Justice, Zucker, & Kilday, 2009; Meisels, Liaw, Dorfman, & Nelson, 1995). Hence, in the context of preschool inclusive classrooms, the current study viewed teacher report as the most appropriate way to assess children's social interactions, specifically, the interaction intensity between every pair of children in the classroom. In all, two specific questions were addressed:

- 1 To what extent do peer language resources vary across individual children within preschool inclusive classrooms, and to what extent is the amount of peer language resources associated with children's disability status and language ability?
- 2 To what extent are peer language resources associated with children's language ability in the spring, controlling for their language ability in the fall and the average language ability of the classroom, and how does the association vary by children's disability status?

2. Method

2.1. Participants

The participants were drawn from a larger randomized controlled trial (RCT) testing the effects of an early language and literacy intervention in the 2013–2014 academic year. As the conditions of the RCT were not designed to influence children's peer social interaction, the current study included both intervention and control classrooms to maximize the statistical power and generalizability of the results. Participants were children and lead teachers affiliated with 108 early childhood special education classrooms in two states, Ohio and Pennsylvania. As part of the RCT, caregiver consent to participate was solicited for all children who had sufficient verbal ability to understand English with basic proficiency (i.e., able to speak in at least two-word utterances; e.g., I want; he goes), and did not have any severe impairment that would make the assessments inappropriate, per teacher and per parent report. For the larger project, based on teacher reports, the actual classroom size ranged from three to 29 ($M = 13.05$, $SD = 5.55$). Based on the consent process, between two and 11 children from each classroom participated in the larger project (i.e., effective classroom size). The consent rate, calculated by dividing the effective classroom size by the actual classroom size based on teacher report, ranged from 10% to 100% ($M = .55$, $SD = .26$).

For the current study, a subset of classrooms was selected from the enrolled 108 classrooms. First, a classroom needed to be inclusive, enrolling both children with disabilities and children who are typically developing, thus allowing investigation of peer social interaction for both subgroups of children. Second, the classroom contained at least four consented children since four children per classroom has been applied in the literature to study

peer effects on preschoolers' language development (e.g., Lin et al., 2016; Mashburn et al., 2009). Third, at least 25% of all the children in a classroom were consented to participate in the study, which allowed reasonable representations of the classroom peer social networks. This cutoff was chosen based on the state guidelines suggest a 50/50 classroom composition model (i.e., eight children with disabilities and eight children without disabilities) and the second selection criterion ensuring at least four consented children per classroom. These inclusionary criteria resulted in a total sample size of 58 inclusive preschool classrooms with 448 children (257 boys, 191 girls). The effective classroom size ranged from four to 11 ($M = 7.72$, $SD = 2.01$). The extreme situation (i.e., effective classroom size = 4) happened to three of our selected classrooms. Their actual classroom sizes reported by teachers ranged from seven to 12, and, therefore, the consent rates were at least 33%.

As presented in Table 1, children's average age in months was 52.29 ($SD = 6.19$), and the majority of children were Caucasian (73%, $n = 328$). Socio-demographic data regarding children and their families were captured using caregiver report questionnaires in the fall of the year. Regarding highest level of maternal education, 7% of mothers did not have a high school diploma, 27% had a high school diploma, 36% had some college or a two-year degree, 16% had a Bachelor's degree, 12% had a Master's degree, and 2% had a Doctoral degree. The median of the overall annual household income level was \$40,001–60,000, and the modes were \$20,000 or less and \$20,001–\$40,000.

Based on teachers' reports, 40% of the children ($n = 178$) had identified disabilities as operationalized by having an Individualized Educational Plan (IEP) and receiving special-education services. Parents were asked to report children's primary disability type if it was known. Thirty-six percent ($n = 64$) of the children with IEPs had a speech/language impairment, 16.9% ($n = 30$) had a developmental delay, 16.3% ($n = 29$) had multiple disabilities, 4.5% ($n = 8$) had autism spectrum disorder, and 5.6% ($n = 10$) had emotional disturbance, orthopedic impairment, specific learning disability, visual impairment, hearing impairment, or other health impairment. For the remaining 20.8% of children ($n = 37$), no specific diagnoses were reported by parents.

Serving as informers of peer social interaction, characteristics of the lead teachers may be of interest. All the 58 lead teachers were Caucasian. The majority of them were female (61%) and held a Bachelor's degree or higher (81%). They had one or multiple majors in early childhood education (55%), special education (45%), elementary education (9%), and other (14%). Majorities of the lead teachers (90%) reported that, including themselves, there were two or three adults in the classrooms, and the rest has only one or more than three adults were in their classrooms.

2.2. Measures

The study measures were used to represent children's language skill in the fall (October) and spring (March) of the academic year. Classroom peer social interactions were assessed in the spring but focused on what happened during the prior three months of typical school days. Peers' language skills and the intensity of social interactions with each peer were used to derive an index of each individual child's peer language resources.

2.2.1. Language skill

Children's language skill was assessed using the *Comprehensive Evaluation of Language Fundamentals Preschool – Second Edition* (CELF-P2, Wiig, Secord, & Semel, 2004). The CELF-P2 is an individually administered, norm-referenced measure of receptive and expressive language skills. Three subscales were used to derive an overall composite (i.e., Expressive Vocabulary, Sentence Structure, Word Structure). The raw scores of the overall composite were used

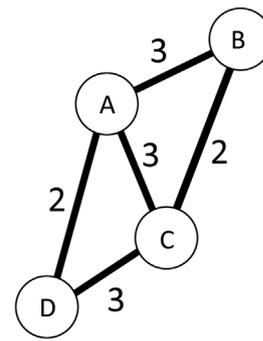


Fig. 1. An example of classroom peer social interactions.

Note. The circles with letters refer to four different children. The interaction intensities (0 = Never play, 4 = Always play) rated by the teacher are marked by the edges connecting pairs of children.

in the analysis. Theoretically, the raw score could range from zero to 86. The assessment was administered by research staff following extensive practice sessions and took approximately 30 mins to administer per child. The CELF-P2 has shown high reliability and validity in the literature (Reilly et al., 2010; Wiig et al., 2004), as well as in the current study, with Cronbach's alpha for the three subscales .72, .70, and .79 respectively.

2.2.2. Peer social interactions

Children's peer social interactions, specifically the interaction intensity between pairs of children, were captured using a teacher-report instrument implemented in the spring of the year. Interaction intensity is a dyadic-level concept, which represents the extent to which a pair of children engage in play-based peer social interactions in the classroom. The teacher-report instrument, developed for the larger project (see Chen et al., 2017), provides teachers with descriptions of play-based social interaction behaviors, including engaging in pretend play, giving and sharing toys, exploring objects together, and collaborating on building blocks. Then, teachers are asked to rate the interaction intensity of each pair of consented children in their classroom during a typical school day based on their observations over the last three months. The scale of teacher rating ranged from zero to four (0 = never play, 1 = rarely play, 2 = sometimes play, 3 = often play, 4 = always play). Researchers suggest that this teacher report approach is reliable and yields congruent information with researcher observations in capturing classroom peer-social interactions (Chen et al., 2017; Gest et al., 2003; Lin et al., 2016). The construct validity of this approach has been evidenced in the literature that the amount of peer interactions associated with individual children is positively associated with children's learning-related behaviors and their attention control and adaptive behaviors (Lin et al., 2019).

At the child-level, each child's average interaction intensity with classmates was calculated based on the mean of interaction intensities of all the teacher-rated peer interactions associated with the child in the classroom. For instance, in a classroom with four consented children (Fig. 1), the teacher-rated the interaction intensities of all the six possible dyads (i.e., children dyads A–B, A–C, A–D, B–C, B–D, and C–D) as 3, 3, 2, 2, 0, and 3, respectively. The average interaction intensity of Child A would be the sum of interaction intensities associated with this child (3 + 3 + 2) divided by effective classroom size minus one (4 – 1), which was 2.67. The theoretic range of average interaction intensity was the same as the teacher rating scale, which ranged from zero to four.

2.2.3. Peer language resources

As a child-level characteristic, a measure of peer language resources was calculated to represent the amount of language

Table 1
Descriptive statistics of child and classroom characteristics in the current study.

	Missing	<i>n</i>	%	Mean	SD	Range
Child characteristics						
Gender	0					
Boy		257	57			
Girl		191	43			
Race	9					
Caucasian		328	75			
Other		111	25			
Disability status	0					
Without IEP		270	60			
With IEP		178	40			
Maternal education	25					
High school or below, no diploma		31	7			
High school		113	27			
Some college or a 2-year degree		153	36			
Bachelor's degree		69	16			
Master's degree		50	12			
Doctoral degree		7	2			
Annual household income	122					
\$20,000 or less		77	24			
\$20,001–\$40,000		77	24			
\$40,001–\$60,000		47	14			
\$60,001–\$100,000		61	19			
\$100,000–\$150,000		42	13			
More than \$150,000		22	7			
Age in month	0	448		52.29	6.19	33–67
Language ability (pretest raw scores)	13	435		40.53	18.48	0–82
Language ability (posttest raw scores)	13	435		50.37	17.44	0–82
Average interaction intensity	0	448		1.99	0.63	0–4
Peer language resource (raw score)	0	448		590.62	298.35	0–1543
Peer language resource (<i>z</i> score)	0	448		0.04	1.00	–1.94–3.24
Classroom characteristics						
Classroom size (teacher report)	0	58		14.40	4.28	5–27
Effective classroom size ^a	0	58		7.72	2.01	4–11
Consent rate	0	58		.57	.19	.31–1.00
Proportion of children with disabilities	0	58		.42	.17	.10–.80
Classroom-mean language ability (pretest)	0	58		40.56	9.22	23.50–65.00

Note. ^a The number of children who were consented in a classroom.

resources a child can access through their interactions with their peers in the classroom. Operationally, the amount of peer language resources was the weighted sum of peers' language abilities. Peers' language abilities were represented by their CELF-P2 raw score as assessed in the fall. The weights were the interaction intensities between the child and his/her classmates based on the teacher rating scale. In the example mentioned above (Fig. 1), the interaction intensity between Child A and Child B was 3, that between Child A and Child C was 3, and that between Child A and Child D was 2. Given the language ability (CELF-P2 raw score) of Child B, C, & D were 40, 45, and 50, respectively, the amount of peer language resources for Child A would be ($40 \times 3 + 45 \times 3 + 50 \times 2$). Since the raw scores for peer language resources had a large range (*Min* = 0, *Max* = 1543, see Table 1), standardized scores (i.e., *z* scores) were used in further analyses.

2.3. Data analysis approach

The first set of research questions concerned the extent to which the amount of peer language resources varied across individuals within classrooms, and how children's own language abilities and their disability status were associated with their peer language resources. To address these questions, multilevel linear regression models were applied whereby children's amount of peer language resources was treated as the dependent variable. First, intra-class correlations were calculated to represent the proportion of variance across classrooms and the proportion of variance across individuals within classrooms. Then, children's disability status (1 = with disabilities, 0 = typically developing) and their language ability at pretest were entered as the child-level predictors. Controlled vari-

ables included child characteristics (i.e., gender and age in months) and classroom characteristics (i.e., the effective classroom size, the consent rate, the proportion of children with disabilities, and the classroom-mean language ability). The calculations of the intra-class correlation and the proportions of variance explained by predictors were calculated with the standard processes explained by O'Connell and McCoach (2008).

The second set of research questions examined the association between peer language resources and children's language ability in the spring, controlling for their language ability in the fall as well as the average language ability in the classroom. In addition, we examined the extent to which the association between peer language resources and children's language ability might be moderated by their disability status. A set of multilevel linear regression models were specified with children's language abilities at posttest as the dependent variable. The model specification procedure was as follows: First, the unconditional model and the model with children's language abilities assessed at the pretest were tested to examine the proportions of variance between and within classrooms and the proportion of variance to be explained after the language pretest had been taken into account. Next, the model with all the covariates was included, controlling for classroom-mean language ability and other child and classroom characteristics (i.e., children's age in months, gender, disability status, effective classroom size, classroom consent rate, and classroom proportion of children with disabilities). Then, the main effect of peer language resources was tested. Finally, the interaction effect between peer language resources and disability status was examined.

Table 2
Comparing children with and without disabilities.

	Typically developing children (n = 270)		Children with disabilities (n = 178)		t	df	p	Cohen's d
	Mean	SD	Mean	SD				
Language ability (pretest raw scores)	47.70	14.57	29.67	18.50	11.33	433	<.001	1.08
Language ability (posttest raw scores)	57.23	13.08	39.98	18.09	11.53	433	<.001	1.09
Average interaction intensity ^a	2.11	0.59	1.81	0.65	5.05	446	<.001	0.48
Peer language resource (raw score)	644.20	299.42	509.34	278.43	4.80	446	<.001	0.47
Peer language resource (z score)	0.22	1.01	-0.23	0.94	4.80	446	<.001	0.46

Note. ^a Teachers rated the extent to which pairs of children play with each other on a Likert Scale rating from 0 (*Never Play*) to 4 (*Always Play*). The average interaction intensity refers to the average teacher rating associated with a child.

Table 3
Correlations between peer language resources and other child and classroom characteristics.

	1	2	3	4	5	6	7	8	9
1 Peer language resources (z score)	–								
2 Age in month	.14**	–							
3 Language ability (pretest, raw score)	.38**	.25**	–						
4 Language ability (posttest, raw score)	.37**	.25**	.90**	–					
5 Average interaction intensity	.61**	.03	.28**	.28**	–				
6 Effective classroom size	.53**	.09*	.07	.07	–.08	–			
7 Classroom consent rate	.08	.07	–.10*	–.06	–.03	.31**	–		
8 Classroom proportion of children with disabilities	–.25**	–.05	–.12*	–.11*	.05	–.39**	.05	–	
9 Classroom-mean language ability (pretest)	.53**	.10*	.50**	.43**	.08	.13**	–.20**	–.23**	–

** $p < .01$; * $p < .05$.

3. Results

3.1. Preliminary analysis

Descriptive statistics of child- and classroom-level characteristics are presented in Table 1. The peer language resources (raw scores) ranged from 0 to 1543, for which the distribution was close to normal (*Skewness* = 0.75, *Kurtosis* = .51). Overall, children's language ability (CELF-P2 raw scores) increased from the pretest ($M = 40.53$, $SD = 18.48$, $range = 0–82$), and the posttest ($M = 50.37$, $SD = 17.44$, $range = 0–82$), and the increase was statistically significant ($t = 26.08$, $df = 425$, $p < .001$, *Cohen's d* = 0.55). Children's average interaction intensity with all classmates varied across individuals ($M = 1.99$, $SD = 0.63$, $range = 0–4$), and the classroom-mean language ability (based on CELF-P2 pretest) varied across classrooms ($M = 40.56$, $SD = 9.22$, $range = 23.50–65.00$).

Typically developing children and those with disabilities were compared in terms of their language abilities, average interaction intensity, and peer language resources. Results of independent *t*-tests showed that typically developing children outperformed children with disabilities in terms of each of these characteristics (see Table 2); the differences were significant at the .001 alpha level with medium to large effect sizes based on Cohen's standard.

The correlations between peer language resources and other child- and classroom-level characteristics are presented in Table 3. Peer language resource was positively correlated with children's age in months, language ability at both pre- and posttest, average interaction intensity, effective classroom size, and classroom-mean language ability, but was negatively associated with the proportion of children with disabilities in the classroom. All of these correlation coefficients were significant at the .01 alpha level. Not surprisingly, children's language ability at pre- and post-test were highly correlated ($r = .90$, $p < .01$).

3.2. Variations of peer language resources within classrooms

The first set of research questions examined variations in peer language resources among children within the participating classrooms and examined these variations by children's language ability

Table 4
Variations of peer language resources among children within classrooms.

	Model 1.1	Model 1.2
Fixed effects (child-level)		
(Intercept)	–0.09(0.12)	–3.92 (0.64)***
Language ability (pretest)		0.08 (0.03)**
Disability (1 = with disabilities, 0 = typically developing)		–0.27 (0.06)***
Gender (1 = girl, 0 = boy)		–0.10 (0.05)*
Age in month		0.00 (0.00)
Fixed effects (class-level)		
Effective classroom size		0.26 (0.04)***
Consent rate		0.12 (0.34)
Proportion of children with disabilities		0.44 (0.51)
Classroom-mean language ability		0.04 (0.01)***
Random effects		
Between-class variance	0.74	0.26
Within-class variance	0.25	0.21
AIC	834.13	746.37
BIC	846.44	791.20
Log likelihood	–414.06	–362.19

*** $p < .001$; ** $p < .01$; * $p < .05$.

at pretest and their disability status. As presented in Table 4, based on the unconditional model (Model 1.1), the intra-class correlation was .75 ($=0.74/(0.74 + 0.25)$). It indicated that the majority (75%) of the variation in peer language resources lay between classrooms, while 25% of the variance was between children within classrooms.

As presented in Model 1.2, individual children's language ability at pretest was a positive predictor of their peer language resources ($r = 0.08$, $p < .01$). Children with disabilities had significantly fewer peer language resources than their typically developing classmates ($r = -0.27$, $p < .001$). Among the controlled variables, girls had fewer peer language resources when language ability, disability status, and other variables had been taken into account ($r = -0.10$, $p < .05$). At the classroom level, effective classroom size and classroom-mean language ability showed positive association with children's peer language resources ($r = 0.26$, $p < .001$; $r = 0.04$, $p < .001$, respectively). Children's age in month, classroom consent rate, and classroom proportion of children with disabilities did not show any

Table 5
The effect of peer language resources on language growth.

	Model 2.1	Model 2.2	Model 2.3	Model 2.4	Model 2.5
Fixed effects (child-level)					
(Intercept)	50.25(1.11)***	50.25(1.11)***	14.00(4.82)**	17.23(5.46)**	17.77(5.47)**
Language ability (pretest)		50.25(1.11)***	0.83(0.03)***	0.83(0.03)***	0.82(0.03)***
Age in month			0.06(0.06)	0.06(0.06)	0.05(0.06)
Gender (1 = girl, 0 = boy)			0.10(0.76)	0.17(0.76)	0.10(0.76)
Disability (1 = with disabilities, 0 = typically developing)			−1.83(0.94)	−1.63(0.95)	−1.60(0.94)
Peer language resources (PLR)				0.74(0.59)	0.08(0.65)
PLR × disability					1.84(0.77)*
Fixed effects (class-level)					
Effective classroom size			0.05(0.27)	−0.14(0.32)	−0.17(0.32)
Consent rate			1.58(2.12)	1.50(2.11)	1.59(2.13)
Proportion of children with disabilities			−0.83(3.28)	−1.23(3.28)	−1.07(3.30)
Classroom-mean language ability			−0.01(0.06)	−0.05(0.06)	−0.03(0.06)
Random effects					
Between-class variance	33.88	3.78	3.91	3.86	4.08
Within-class variance	270.86	54.22	54.11	54.06	53.30
AIC	3712.05	2945.5	2950.66	2950.31	2945.33
BIC	3724.28	2961.71	2995.26	2998.96	2998.04
Log Likelihood	−1853.03	−1468.75	−1464.33	−1463.15	−1459.67

*** $p < .001$; ** $p < .01$; * $p < .05$.

significant relation with peer language resources. With all above mentioned variables included, the model explained 16% ($= (0.25 - 0.21)/0.25$) of the within-class variance and 65% ($= (0.74 - 0.26)/0.74$) of the between-class variance.

3.3. The association between peer language resources and children's language growth

The second set of research questions focused on the association between peer language resources and children's language ability in the spring controlling for their language ability in the fall as well as classmates' average language ability in the classroom. In addition, we tested the potential moderation effect of disability status on the association between peer language resources and children's language ability.

As presented in Table 5, the unconditional model (Model 2.1) was examined first, followed by the model including children's language ability at pretest (Model 2.2) to partial out the pretest variance. The results of the un-conditional model showed that 11% ($= 33.88 / (33.88 + 270.86)$) of the variance in language ability at posttest lay between classrooms, while the remaining 89% existed within classrooms. Comparing Model 2.1 with the unconditional model, language ability at pretest explained 89% ($= (33.88 - 3.77) / 33.88$) of the between-classroom variance and 80% ($= (270.86 - 54.22) / 270.86$) of the within-classroom variance. Controlled variables were entered in Model 2.3. Surprisingly, classroom-mean language ability did not show a significant effect. None of the covariates (i.e., gender, age in months, effective classroom size, consent rate, and proportion of children with disabilities) was a significant predictor.

The main effect of peer language resources was included in Model 2.4. The results showed that, regardless of the positive tendency, peer language resources did not show a significant association with children's language ability at posttest, controlling for their pretest scores and the other covariates. However, Model 2.5 showed a significant effect for the interaction between peer language resources and children's disability status on children's posttest language ability ($r = 1.84, p < .05$). This interaction effect suggested that the effect of peer language resources on children's language growth was greater for children with disabilities than for typically developing children. The other effects remained similar compared to the previous model. Compared to Model 2.3, peer language resources and its interaction effect with disability sta-

tus explained an additional 1.50% ($= (54.11 - 53.30) / 54.11$) of the within-classroom variance, when the proportion explained by language ability at pretest and the other covariates had been partialled out.

4. Discussion

Peers play an essential role in early childhood language development, as shown in part through the examination of "peer effects" in the literature (e.g., Justice et al., 2011; Mashburn et al., 2009; Ribeiro et al., 2017). Such work suggests that young children's interactions with peers in the preschool classroom are a significant mechanism through which children's language skills are developed. The current study makes a unique contribution to this body of literature by considering the individual differences in children's access to language resources through peer social interactions (i.e., peer language resources). Methodologically, we examined the contribution of peer language skills to a child's language gain as a function of interacting with peers with different language abilities at various intensities. Within the specific context of preschool inclusive classrooms, this study highlighted the significant variation of peer language resources within the classrooms and its association with language growth during a school year especially for children with disabilities.

We highlight several key findings, the first of which was that children's access to peer language resources differed considerably, even within the same classroom. Indeed, our results indicated that a significant proportion of variation (26%) lay within the inclusive preschool classrooms. Children who had stronger language skills or those who were typically developing had more peer language resources than those children who had poorer language skills or those who had at least one type of disability. These findings may be explained by the homophily effects in peer social interactions which suggest that children tend to interact with peers who share the same or similar characteristics, such as language ability and disability status (e.g., Chen et al., 2017; Lin et al., 2016). Our work extends previous findings by showing that not only do children with stronger language skills tend to interact with peers who also have similarly strong language skills, but that these interactions allow them to be exposed to more language resources than children with poorer language skills, as their peer language resources primarily include peers with similarly low language abilities. Hence,

our results highlight the importance of moving beyond the overall classroom language ability by considering individual differences in peer social interactions when examining peer effects on children's language development.

In addition, the effect of disability status was above and beyond the effect of language ability. This finding aligns with literature showing that children with disabilities are less likely to engage in peer social interactions, especially to form interactions with their typically developing peers (e.g., [Chen et al., 2018, 2017](#)). Such constrained peer social interactions would limit the language resources children with disabilities can access from peers. Not surprisingly, the effective classroom size contributed to the amount of peer language resources, since the peer language resource was operated as an aggregation of peers' language abilities. This positive association is conceptually meaningful because children would have greater opportunities to interact with peers in larger classrooms, through which they could potentially access more language resources. However, it has to be acknowledged that the majority of the effective classroom sizes in the current sample were relatively small, ranging from four to eleven, and included only children who were consented. Thus, results pertaining to the positive linear relation between classroom size and peer language resources should be interpreted with caution.

The second major finding was that the association between peer language resources and language growth was stronger for children with disabilities than typically developing children. Although children with disabilities had fewer peer language resources compared to their typically developing peers, the interaction effect between peer language resources and disability status was significant when predicting language growth. As such, peer language resources had greater effects in promoting language abilities for children with disabilities than their typical peers, although we lack evidence to argue the effect of peer language resources on language growth for typically developing children based on the current results. This significant interaction effect aligns with the extant literature on peer effects, which suggests that children with lower abilities can benefit more than children with higher abilities from having highly skilled classmates (e.g., [Justice et al., 2011, 2014](#)). Grounded in social learning theory ([Bandura, 1971](#)), a possible explanation for this phenomenon is that children learn from each other when they are engaged in peer social interactions. Although children with disabilities tend to have lower language abilities than their typical peers, the peer social interactions children with disabilities engaged in the classroom may provide advantages for their language development. Our findings indicate that teachers probably should be mindful when children with disabilities exclusively interact with peers with low language abilities, which can be driven by the language homophily tendency as discussed above. Instead, teachers would enrich peer language resources and benefit language development for children with disabilities by encouraging and facilitating their interactions with peers who have higher language abilities. For instance, teachers could consider children's language abilities when assigning children to different groups during activities to ensure that children with lower language skills have access to children with higher language skills.

It needs to be acknowledged that the effect size of peer language resources was small. In addition, peer language resources was not a significant predictor of children's language growth for the full sample of children, which has been documented in the literature examining the influence of classroom-aggregated constructs on children's development over an academic year (e.g., [Guo, Tompkins, Justice, & Petscher, 2014; Justice et al., 2011](#)). A possible explanation is the high correlation between children's spring and fall language scores, although children's language ability significantly increased within the academic year as presented in the descriptive statistics in the previous section. In the current study,

the correlation was .90, so that the pretest score alone explained 80% of the within-classroom variance in the model predicting the posttest scores. As presented in the appendix, we did a supplementary analysis, testing the association between the language ability assessed at posttest and peer language resources without controlling for the language ability at pretest. The results showed that peer language resources showed a unique significant effect, which was above and beyond the relation between classroom-mean language ability and children's language ability. Hence, the small effect of peer language resources evidenced in the current study may capture an important nuance in the classroom experience, which can be especially salient for children who have disabilities.

4.1. *Limitations and future directions*

Regardless of the major findings, the current study has several limitations. First, the interaction intensity between pairs of children was reported by teachers, which could be biased by teachers' perceptions of certain children. However, we elected to rely on teacher report, as preschool children's self-report, especially those from children with disabilities, may not be reliable ([Lin et al., 2016; Robertson et al., 2003; Shin et al., 2014](#)) and teachers are more reliable than researcher observations on children's peer social interactions in classrooms based on their ongoing observations across classroom activities and context ([Cabell et al., 2009; Meisels et al., 1995](#)). Still, future studies are needed to further justify the reliability of teacher-rated peer social interactions.

Second, peer social interactions were assessed only once at the beginning of the spring semester. It is possible that children may change their interaction intensity with certain classmates over the school year. However, assessing social interactions at the beginning of the academic year poses challenges because children are getting to know one another and developing their peer relationships. To combat these challenges, the current study asked teachers to rate the interaction intensity between pairs of children, considering the situation in a typical school day over the past three months within the spring semester.

Third, although teachers were provided with examples of play interactions when rating the interaction intensity between pairs of children, we do not have data on exactly what happened during peer social interactions (e.g., the exact dialogues). There could be discrepancies between potential language resources based on peers' language abilities and the actual language input children can access through interacting with peers. It is possible that peers' talkativeness and the sophistication of their oral expressions do not fully match with their language scores on a standardized test, although it comprehensively takes into account both receptive and expressive language skills. In addition, peers can adjust their use of language when talking to different addressees (i.e., code-switching; [Gleason, 1973; Ervin-Tripp & Reyes, 2005](#)), such as using simpler sentences and words when talking to children with low language abilities. Moreover, teachers' group strategies and instructional approaches would play essential roles in influencing children's opportunities for interacting with different peers and their tendencies of using simple or complex languages. Future research needs to apply a more fine-grained approach to examine the process of social interactions and dialogues among peers, as well as the classroom instructional context, to better understand the mechanism through which peer language resources affect children's language growth.

In addition, we were not able to include all the language input from peers nor to control for language input from adults when examining the relation between peer language resources and children's language growth. On one hand, we could only include peers who were consented, which on average represented 57% of the children in the classroom. However, even with this underestimated

language input, we demonstrated its positive association with children's language growth especially for those with disabilities. On the other hand, besides peer effects, children's language ability can be affected by language input from teachers and caregivers. However, we did not have indicators to control for the effects of adults who may have intensive interactions with children. Future research may simultaneously take into account language input from peers, from teachers, and caregivers to have more comprehensive understandings in terms of how language input from each aspect of children's social context may play a unique role in their language growth.

Regardless of the above limitations, this study emphasizes the importance of considering individual differences in peer social interactions and demonstrated the unique association between peer language resources and children's language growth after the average language ability of the classroom has been taken into account. Particularly, our findings offer practical suggestions that teachers may promote language development especially for children with disabilities by enriching their peer language resources and facilitating their social interactions with peers who have higher language abilities. In addition, the findings indicate that peer-mediated interventions could be a potential approach to promote children's language growth. However, future studies are needed to further understand the process and the mechanism of the peer effect in conjunction with language input from teachers and caregivers.

CRedit authorship contribution statement

Jing Chen: Conceptualization, Methodology, Formal analysis, Data curation, Writing - original draft, Writing - review & editing. **Laura M. Justice:** Conceptualization, Writing - review & editing, Project administration, Funding acquisition. **Sherine R. Tambyraja:** Writing - review & editing, Project administration. **Brook Sawyer:** Writing - review & editing, Funding acquisition.

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Appendix A. Supplementary data

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