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Measuring Growth in Bilingual and Monolingual Children's English Productive Vocabulary Development: The Utility of Combining Parent and Teacher Report

Shaher Banu Vagh, Barbara Alexander Pan, and Jeannette Mancilla-Martinez
Harvard Graduate School of Education

This longitudinal study examined growth in the English productive vocabularies of bilingual and monolingual children between ages 24 and 36 months and explored the utility and validity of supplementing parent reports with teacher reports to improve the estimation of children's vocabulary. Low-income, English-speaking and English/Spanish-speaking parents and Early Head Start and Head Start program teachers completed the MacArthur–Bates Communicative Development Inventory, Words and Sentences for 85 children. Results indicate faster growth rates for monolingual than for bilingual children and larger vocabularies for bilingual children who spoke mostly English than mostly Spanish at home. Parent–teacher composite reports, like parent reports, significantly related to children's directly assessed productive vocabulary at ages 30 and 36 months, but parent reports fit the model better. Implications for vocabulary assessment are discussed.

Assessment of very young children's vocabulary development is challenging at best, but tracking children's vocabulary development is critical for intervention programs such as Early Head Start (EHS) and Head Start (HS), given the strong relation between children's early vocabulary knowledge and later academic success (Dickinson & Tabors, 2001; Snow, Burns, & Griffin, 1998). One tool that has proven to be user friendly, cost effective, and reliable in measuring vocabulary development of children learning a single language is the MacArthur–Bates Communicative Development Inventory, long and short forms (CDI; Fenson et al., 1993). However, a methodological challenge for children who are English language learners is to obtain a comprehensive picture of their developing English vocabularies from parent reports alone. Recent evidence indicates that even for monolingual children, report by a single familiar adult may underestimate young children's vocabulary knowledge (De Houwer, Bornstein, & Leach, 2005). For the rapidly increasing number of children in EHS and HS programs who speak a language other than English at home (Administration for Children and Families, 2007), parental report alone may underestimate children's English vocabulary knowledge even more seriously. Given that teachers have the opportunity to observe and interact with children in different activities, and with bilingual children potentially more often in English, than do parents, the supplementing of parent report with teacher report may provide a more complete picture of children's developing English vocabulary knowledge. Thus, one aim of this study is to explore the utility and validity of integrating parent and teacher CDI reports for children from monolingual and bilingual low-income families.

Two risk factors widely associated with low levels of vocabulary acquisition are low socioeconomic status (Hart & Risley, 1995) and minority language learner status (August & Shanahan, 2006). Given that children from Spanish-speaking homes continue to be overrepresented among America's poor (Suárez-Orozco & Páez, 2002), these children are at increased risk for low levels of English vocabulary acquisition, which in turn bodes unfavorably for their future academic success. Despite much concern about early vocabulary development for young children from these backgrounds, there is little work examining their English vocabulary development over time. This limits our understanding of what constitutes typical vocabulary development

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Correspondence concerning this article should be addressed to Shaher Banu Vagh, Larsen 305, Harvard Graduate School of Education, Cambridge, MA 02138. Electronic mail may be sent to shahervagh@gmail.com.

for English language learners who are increasingly being served by EHS and HS, as well as state-funded preschool programs. Such an understanding is crucial to address concerns about low levels of vocabulary knowledge and the stability of early differences over time (Baker, Simmons, & Kame'enui, 1998; Hart & Risley, 1995). Our present longitudinal study includes children from low-income English-speaking and Spanish- or Spanish/English-speaking families (hereafter on referred to as bilingual). Thus, it provides a unique opportunity to compare the growth rates in the developing English vocabularies of children from low-income monolingual and bilingual families across toddlerhood.

The Utility of Multiple Reporters

In a study with middle- to upper-middle income monolingual Dutch-speaking families, De Houwer et al. (2005) demonstrated that different reporters tended to assess the same child's language ability quite differently. Specifically, even mothers and fathers varied in their estimates of young children's productive and receptive vocabularies, and they in turn differed from a third reporter who was the child's grandparent, aunt, nanny, or child-care provider. The differences in the reports of mothers, fathers, and a third person were more evident for children who demonstrated greater communicative ability than for children who were not as communicative. Although De Houwer et al. did not evaluate the validity of the reports provided by multiple reporters they concluded that even for children as young as 13 months, single reports tend to underestimate children's vocabulary size, especially when children demonstrate greater communicative ability.

Multiple reports are likely to be even more crucial when estimating the English vocabularies of young bilingual children (Marchman & Martinez-Sussmann, 2002; Patterson, 2000). Parents may have a better sense of the child's skills in the home language but have little knowledge of their child's facility in English, whereas teachers may be better judges of the language of instruction or interaction used in child-care and preschool settings. Children may also favor Spanish at home and English at school or for community activities (Tabors, 1997). Furthermore, children may favor English for school-like activities or for sharing school experiences with family members but retain Spanish for other daily activities or topics. It follows then that a parent and a teacher may together provide a more accurate picture of young children's productive vocabularies than would single reports by a parent. Some evidence for the utility of multiple reports is provided by Marchman and Martinez-Sussmann (2002) for a predominantly middle-income, bilingual Spanish–English sample of toddlers of ages 23–34 months. They noted that multiple reporters (i.e., either two parents, or a parent and a nonparent caregiver) were able to provide an estimate of vocabulary size that was ''as good as, and sometimes better than, a single reporter'' (p. 993).

However, there are also several potential concerns about the use of teacher reports. First, the CDI was developed and normed based on parent rather than teacher reports. It is possible, though perhaps unlikely for very young children, that items on the CDI underrepresent those frequently used in child-care settings. Use of the CDI long forms comprising 680 items versus the short forms comprising only 100 items might be expected to decrease this likelihood. Next, unlike parents, teachers interact with several children of similar ages, giving rise to the possibility that teachers may be less able to discriminate among children in their classroom, particularly as children become increasingly communicative and as with increasing age are likely to be in larger classrooms. Previous work with multiple reporters has not included preschool teachers as reporters. Thus, despite the potential benefits of using multiple reports noted earlier, there remains a need for information about the validity and utility of teacher reports.

Tools for Assessing Vocabulary

As noted earlier, the advantages of using the CDI, a reporter-based measure to obtain an understanding of children's vocabulary development, are several. It is cost effective, it is minimally intrusive, it is not context or task specific, it is not hindered by children's ability to follow instructions, it is not contingent on children's attentional state, and it is more feasible to use for repeated assessments. Furthermore, the validity and reliability of CDI parent reports have been well documented (Fenson et al., 1994). One concern is the use of the CDI with children from bilingual families as the instrument was designed for use with monolingual English speakers. Although a study with middle-income Spanish-speaking families has reported significant correlations of acceptable magnitude (rs = .72–.79) between the CDI and analogous vocabulary measures at child ages 23–34 months (Marchman & Martinez-Sussmann, 2002), the correlations reported for children from Spanish-speaking low-income families of similar ages are lower albeit significant

(r = .42; Akers, Boyce, Innocenti, Cook, & Ortiz, 2005). Relatedly, Pan, Rowe, Spier, and LeMonda (2004) reported significant moderate correlations (rs = .49–.50) between the CDI short forms and observed and direct assessments of children's language production for monolingual English and English-dominant children from low-income families. In the study by Pan et al. (2004), too, the magnitudes of these correlations were not as high as those typically reported for middle-income monolingual English families. Given the limited number of validation studies with children from low-income and bilingual families and the cautions noted by several researchers about the use of the CDI with children from these backgrounds, we also sought to address the validity of the parent CDI reports for our sample of low-income and bilingual families.

To the best of our knowledge, this is the first study where teachers were asked to report on young children's vocabulary knowledge by completing the CDI checklists. Given the several concerns noted earlier about teachers reporting on individual children in their classroom, we also examined the validity of the teacher CDI reports including their associations with parent reports. Finally, as our primary interest was in understanding the utility of the composite parent–teacher reports, we also examined the validity of the composite scores.

Our specific research questions for this study were:

1. How does growth in the developing English vocabularies of children from low-income bilingual families compare with growth in the developing English vocabularies of children from low-income monolingual families across toddlerhood as reported by parents and teachers?
2. Do multiple reporters—parents and teachers—provide a more comprehensive estimation of English vocabulary knowledge compared to single parent reports for children from monolingual and bilingual families across toddlerhood? If so, then does the contribution of teacher reports differ for children from bilingual and monolingual families across toddlerhood?
3. Are parent reports, teacher reports, and parent–teacher composite reports valid estimations of English vocabulary knowledge for children from bilingual and monolingual families when compared to concurrent, direct vocabulary assessments (Peabody Picture Vocabulary Test [PPVT–III] and Woodcock Language Proficiency Battery–Revised [WLPB–R]) at child ages 30 and 36 months?
4. Finally, what is the utility of parent–teacher composite reports? In other words, are parent–teacher composite reports as strongly or more strongly associated with children's direct vocabulary assessments (PPVT–III and WLPB–R) at child ages 30 and 36 months than the single parent report measure?

Method

Participants

The 85 study participants were drawn from a larger sample of 118 families participating in EHS or HS collaborative programs in New England. Of the 118 families, 16 Spanish-speaking parents indicated inability to report on their children's English productive vocabularies, and for 17 families only the parent or only the teacher had completed CDI reports at any child age. The sample for the present study thus comprised 85 families for whom both parent and teacher reports were available. Families were recruited into the study when children were aged 24, 30, or 36 months. The staggered entry of children into the study enabled us to obtain repeated measures over a longer time period despite collecting fewer waves of data for each participant and consequently lessening the burden on families. No significant differences were noted between children who entered the study at different ages (see Appendix A and Table A1). Of the 85 families, 34 children entered the study at age 24 months, 24 children entered the study at age 30 months, and 27 children entered the study at age 36 months. Twenty-nine families were monolingual English speaking, and 56 families reported Spanish or Spanish and English as their home language(s).

Parent and teacher CDI reports were available for 24 children at child age 24 months, for 25 children at age 27 months, for 35 children at age 30 months, for 28 children at age 33 months, and for 46 children at age 36 months. Four children had data for all five waves, 2 children had data for four waves, 16 children had data for three waves, 19 children had data for two waves, and 44 children had data at one wave. Not all children are represented at each time point, either because the child had not yet entered the program or research study or because one or both reporters failed to complete the form within the project-specified window, that is, 2 weeks prior to and 2 weeks later than the target age. No significant differences were noted between children who

contributed one wave of data versus children who contributed two or more waves of data (see Appendix A and Table A2). Nor were significant differences noted between children who had matched parent–teacher reports at one or more time point versus children who did not have matched parent–teacher reports at any time point and therefore were not included in the present sample (see Appendix A and Table A3).

Nearly, all children (98%) were born in the United States, although 50% of the mothers and 55% of the fathers were born in other countries—chiefly the Dominican Republic and Puerto Rico. Fifty-one percent of the children were female and 40% were firstborn. Fifty-seven percent of the children were identified by parents as Hispanic or Latino, 27% Black, 5% White, and 11% were reported to be of mixed race. The reported input to most children by their parents was primarily Spanish. Specifically, 55% of mothers and 70% of fathers reported using primarily Spanish with the child, 30% of mothers and 13% of fathers reported using English and Spanish equally, and 15% of mothers and 17% of fathers reported using primarily English. The patterns of child language use to parents at home were often different from parents' language directed to them. Thirty-five percent of the children were reported to use primarily Spanish with parents, 42% of the children were reported to use primarily English, 19% were reported to use English and Spanish in equal measure, and 6% were reported to use Spanish with one parent and English with the other.

Annual median family income as reported by the primary caregiver at baseline was in the range of $10,000–$19,999. On average, mothers and fathers reported completing about 13 and 12 years of formal schooling (*SD*s = 2.69 and 3.33), respectively. In 76% of the families, mothers and fathers reported being the primary caregivers for the child. For 15% of the families, mothers were the sole primary caregiver and in the remaining families this responsibility was shared between the mother and grandfather (4%), between the mother and stepfather (1%), between the grandmother and father (1%), solely by the grandmother (2%), and solely by the father (1%). All children were reported to be living with their female primary caregiver (95% mothers and 4% grandmothers) except for one child who lived with the father.

Procedure

Children's primary caregiver, usually the mother (93%), was interviewed at study entry. Hence, we refer to the respondents hereafter as parents. Parent interviews were available in both Spanish and English and were conducted by trained, bilingual research assistants in the parents' language of choice. Parent interviews provided information about relevant demographic indices and English–Spanish language exposure and use for children from bilingual homes. Parent interview data is missing for 6 families from the full sample of 118 due to scheduling issues.

Parents and teachers completed the MacArthur–Bates CDI: Words and Sentences (toddler long form; Fenson et al., 1993) at entry and every 3 months thereafter. Hence, the CDI checklists were completed by parents and teachers when children were approximately ages 24, 27, 30, 33, and 36 months. A 1-month window, that is, 2 weeks before to 2 weeks after the target age, was allowed for the completion of the CDI forms. Although the CDI toddler long forms are designed for use with children aged 14–30 months, we used them up through child age 36 months because we did not expect our sample of low-income and non-native English-speaking children to reach ceiling in this age range.

Bilingual parents were allowed to determine whether they could report on their children's English productive vocabularies. As noted earlier, 16 Spanish-speaking parents opted out indicating their inability to report on English. One hundred eleven teachers reported on between one and five children in their classroom. As children moved to a different classroom or as classroom teachers changed, the teacher completing CDI reports for a given child inevitably was not always the same individual over time. Trained, bilingual research assistants met with parents to complete the CDI forms. Teachers completed the forms on their own, which were collected by the research assistants. Parents and teachers were asked to report on words ''produced'' by the child rather than imitations or elicited repetitions.

High internal consistency (Cronbach's alpha = .96) and high test–retest correlations (.95) are reported for the CDI long form (Fenson et al., 1993). The CDI long form is a checklist measure comprising 680 words grouped in semantic categories. The total number of words checked yielded scores of children's productive vocabularies as reported by parents and as reported by teachers. Additionally, a third score was computed by providing a single credit for words reported by one or both reporters (De Houwer et al., 2005). Thus the composite score was a sum of (a) words that were reported in

common by parent and teacher (given a single credit), (b) words that were uniquely reported by the teacher, and (c) words uniquely reported by the parent. The three scores—parent CDI scores, teacher CDI scores, and composite CDI scores—served as outcome measures.

The Picture Vocabulary subtest of WLPB–R (Woodcock, 1995) and the PPVT–III (Dunn & Dunn, 1997), individually administered at child ages 30 and 36 months, provided direct measures of productive and receptive vocabulary, respectively. Like the CDI, the WLPB–R and the PPVT–III were conducted within the 1-month project-specified window of 2 weeks before to 2 weeks after the target age. The test–retest reliabilities for the Picture Vocabulary subtest of the WLPB–R are .86 and for the PPVT–III is .92. These measures served to determine the validity of parent, teacher, and composite CDI scores.

Children's Productive Vocabularies Based on Parent, Teacher, and Parent–Teacher Composite Reports

As children's family language status was a primary predictor of interest, we examined parent, teacher, and parent–teacher composite scores separately for children from monolingual English families, and bilingual Spanish or Spanish–English families (see Table 1).

Substantial variability was noted in parent, teacher, and parent–teacher composite reports of children's productive vocabularies for children from monolingual families and for children from bilingual families. For instance, the productive vocabularies of children from monolingual families at age 24 months ranged from 29 to 584 words based on parent reports, and from 4 to 597 words based on teacher reports. For children from bilingual families, productive vocabularies at age 24 months ranged from 9 to 512 words for parent reports and from 8 to 351 words for teacher reports. Similar variability was reflected in the parent–teacher composite scores for both groups of children (see Table 1). Next, comparing across the monolingual and bilingual groups of children, at each time point average reported productive vocabularies were larger for children from English-speaking families than for children from bilingual families, and the average reported productive vocabularies progressively increased over time from age 24 to 36 months, except for a slight slump in the average productive vocabularies for both groups of children at ages 33 and 36 months as reported by teachers. Also, parents of children from monolingual families reported higher productive vocabularies on average at each time point than did teachers. For children from bilingual families, the pattern was mixed, with teachers reporting higher average productive vocabularies than parents at ages 24 and 27 months, and the reverse at child ages 30, 33, and 36 months.

Additionally, and importantly, none of the children attained the maximum score of 680 words at any time point including ages 33 and 36 months, which are beyond the age range for which the CDI: Words and Sentences checklist was designed. This suggests that these checklists are appropriate for use beyond child age 30 months and up to at least age 36 months for children from English-speaking and bilingual low-income families, as no ceiling effects were obtained and wide variation was captured by these checklists at these two time points.

Analytic Approach

Individual growth modeling was used to analyze the longitudinal data in order (a) to examine growth in the developing productive vocabularies of children from monolingual and bilingual families as reported by parents and teachers and (b) to determine whether multiple reporters—parents and teachers—provide a more comprehensive estimation of children's vocabularies than single parent reports across toddlerhood for children from monolingual and bilingual families. We also examined the percent agreement of words reported by parents and teachers and the association between parent and teacher reports at each time point. Additionally, significance tests of sample mean, that is, *t* tests, were conducted to assess whether the unique contribution of teacher reports to the composite score of children from bilingual families was significantly different from that of their contribution to children from monolingual families at the different child ages.

The analyses for individual growth modeling were conducted using SAS PROC MIXED, full maximum likelihood method. The advantage of individual growth modeling techniques is that they can easily handle data sets that are missing data at one or more time points (Singer & Willett, 2003). However children with just one wave of data did not provide any information to the estimation of the variance components, although they did provide information to the estimation of the fixed effects. Importantly, fitting multilevel models of change allowed us to address our first research question about understanding the patterns of growth in vocabulary over time and how these patterns might

Table 1
Descriptive Statistics for CDI Scores Reported by Parents, Teachers, and a Composite of Parent–Teacher Reports at Child Ages 24, 27, 30, 33, and 36 months and Descriptive Statistics for the PPVT–III and the Picture Vocabulary Subtest of the WLPB–R at Child Ages 30 and 33 Months for Children From Monolingual and Bilingual Families

		24 months	27 months	30 months	33 months	36 months
CDI scores						
Bilingual	*n*	13	15	23	17	31
Parent	*M* (*SD*)	118.9 (133.9)	188.0 (166.0)	248.0 (139.8)	302.8 (142.2)	340.6 (139.0)
Teacher	*M* (*SD*)	152.4 (119.4)	191.1 (181.2)	245.3 (186.1)	268.2 (151.0)	195.5 (166.3)
Combined	*M* (*SD*)	218.9 (147.5)	282.2 (195.9)	349.8 (155.8)	429.1 (98.6)	392.6 (154.3)
Monolingual	*n*	11	10	12	11	15
Parent	*M* (*SD*)	229.6 (191.6)	363.4 (159.4)	408.5 (147.5)	524.3 (130.0)	545.5 (108.4)
Teacher	*M* (*SD*)	225.6 (202.9)	247.3 (215.8)	255.4 (183.9)	272.8 (162.3)	253.1 (186.9)
Combined	*M* (*SD*)	343.5 (208.9)	419.4 (176.8)	444.3 (157.8)	557.4 (106.8)	569.6 (101.1)
Direct assessments						
Bilingual	*n*			20		28
WLPB–R raw score	*M* (*SD*)			9.9 (4.8)		12.6 (3.9)
WLPB–R standard score	*M* (*SD*)			89.9 (15.8)		85.4 (11.9)
PPVT–III raw score	*M* (*SD*)		—	11.1 (6.1)		13.9 (5.8)
PPVT–III standard score	*M* (*SD*)	—		71.5 (13.0)	—	72.9 (9.7)
Monolingual	*n*			10		12
WLPB–R raw score	*M* (*SD*)			13.5 (4.8)		17.1 (2.1)
WLPB–R standard score	*M* (*SD*)			101.5 (13.9)		100.8 (10.0)
PPVT–III raw score	*M* (*SD*)		—	16.9 (8.6)		27.4 (11.2)
PPVT–III standard score	*M* (*SD*)	—	—	81.8 (12.3)	—	89.8 (12.6)

Note. PPVT–III = Peabody Picture Vocabulary Test–Third Edition; WLPB–R = Woodcock Language Proficiency Battery–Revised; CDI = MacArthur-Bates Communicative Development Inventory.

differ for children from bilingual and monolingual families. To specify a functional form that best described the patterns of growth in children's productive vocabularies based on parent reports, teacher reports, and parent–teacher composite reports, empirical growth trajectories for all families were examined and a series of baseline models (unconditional mean and unconditional growth models) with various parametrizations of time were compared. The unconditional mean model has no predictors, whereas the unconditional growth model includes the effect of time, that is, child age in this study. The parametrization of time, that is, linear or quadratic, determines the functional form of the model. The unconditional mean model serves as a baseline model against which the unconditional growth model is compared and the unconditional growth model serves as a baseline against which the model including family language status, that is, monolingual or bilingual status, is compared. We also compared these parent and teacher models to the models based on the full sample that is including children who did not have matched parent and teacher reports to ensure that we arrived at an appropriate functional form for each reporter.

Preliminary results indicated that a quadratic model was the best fitting functional form for both parent and teacher reports. However, the model for parent reports based on the larger sample (including parent reports with no matched teacher reports; $n = 101$) indicated that a linear model was the best specification for parent reports. Given that prior studies of young children's developing vocabularies also support a linear trajectory beyond child age 24 months (e.g., Hart & Risley, 1995; Pan, Rowe, Singer, & Snow, 2005), we adopted a linear model for the parent reports. For teacher reports, models based on the current sample ($n = 85$) and the larger sample (including teacher reports with no matched parent reports; $n = 102$) indicated that a curvilinear model was the best functional form to fit the data. Thus, for instance, the following model was fit for the parent CDI reports:

$$\begin{aligned}\text{ParentCDI}_{it} = &\left[\gamma_{00} + \gamma_{10}(\text{ChildAge} - 30)_{it} + \gamma_{01}\text{Biling}_i \right.\\ &\left. + \gamma_{11}(\text{Biling}_i)(\text{ChildAge} - 30)_{it}\right] + [\zeta_{0i} + \varepsilon_{it}]\end{aligned}$$

where

$$\varepsilon_{it} \sim N(0, \sigma_\varepsilon^2) \text{ and } [\zeta_{0i}] \sim N([0], [\sigma_0^2])$$

Here, the subtraction of 30 from child age allowed for a meaningful interpretation of the

parameter estimates: γ_{00} then represents the average reported vocabulary for children at age 30 months by parents, γ_{01} represents the difference in elevation in parent reported vocabulary production for children from monolingual and bilingual families, γ_{10} represents the average growth rate with increasing child age, and γ_{11} represents differences in the growth rates for children from monolingual and bilingual families. The Level 1 residual term, ϵ_{it}, represents that portion of the ith child's vocabulary production at child age t that is not explained by child age. The Level 2 residual term, ζ_{0i}, represents the deviations of each child's growth parameters from the population average for initial status, that is, γ_{00}. However, the inclusion of the random effect associated with the growth term resulted in the error–covariance matrix not being positive definite. This situation can arise if the random effects of the model are overspecified for a data set, as for the present data set, which has a substantial number of children contributing only one wave of data. A practical solution to rectify this issue is to simplify the model by removing the concerned random effect, here, the random effect associated with growth (Singer & Willett, 2003). This strategy, however, still allows us to compare the average differences in vocabulary growth rates (the fixed effects) for children from monolingual and bilingual families thus enabling us to address the first research question of interest. For all models, residuals were examined to confirm that the assumptions of normality and homoskedasticity were adequately met. Model specifications for teacher reports and composite parent–teacher reports are presented in Appendix B.

To address our final two questions, a set of general linear mixed regression models using SAS PROC MIXED were fit to determine the validity of parent reports, teacher reports, and parent–teacher composite reports. In addition, in keeping with previous validation studies of the CDI we also examined correlation coefficients of the CDI reports at 30 and 36 months with concurrent assessments on the WLPB–R and PPVT–III.

The advantage of general linear mixed regression analysis is that it allowed us to account for the effects of child age, home language status, and child language use when examining the associations between the CDI reports and WLPB–R and PPVT–III scores. In these models, the directly measured children's receptive vocabulary (PPVT–III scores) and productive vocabulary scores (WLPB–R scores) at child ages 30 and 36 months served as outcome measures and family language status, child Spanish–English language use, parent reports or teacher reports or parent–teacher composite reports served as predictor variables. As the distribution of PPVT–III scores was positively skewed these scores were square root transformed. Models predicting for the transformed PPVT–III scores were found to fit better than models predicting for the untransformed scores. The sample for the concurrent validity analysis was 57. These were children for whom we had scores on all outcome and predictor measures at child ages 30 and 36 months.

To address the utility of parent–teacher composite reports over parent reports, we first examined the magnitude of the correlation coefficient between the direct vocabulary assessments and the parent reports and the parent–teacher composite reports. Next, we evaluated the overall fit of the general linear mixed regression model including parent reports and the fit of the model including parent–teacher composite reports. Given that the CDI parent, teacher, and composite reports are time-variant predictors, their inclusion in the model can change both the Level 1 (within individual) and Level 2 (between individual) variance components. However, changes in the Level 2 variance component may not be meaningful and cannot be compared across successive models to determine the amount of variation in initial status explained by the parent CDI reports versus composite CDI reports (Singer & Willett, 2003). Hence, the goodness-of-fit statistics for the models were examined to understand which reports provided the best fit when predicting for WLPB–R and PPVT–III scores to shed some light on this question.

Results

How Does Growth in the Developing English Vocabularies of Children From Low-Income Bilingual Families Compare to Growth in the Developing English Vocabularies of Children From Low-Income Monolingual Families Across Toddlerhood as Reported by Parents and Teachers?

Table 2 presents a taxonomy of fitted multilevel models predicting children's productive vocabularies based on parent reports and teacher reports. As mentioned previously, the most appropriate functional form for growth in children's productive vocabularies based on parent reports was a linear trajectory (see Model P2), and the best fitting functional form for the teacher reports was a curvilinear

Table 2
Taxonomy of Fitted Multilevel Models of Change Predicting Children's Productive Vocabularies Based on Parent CDI Reports and Teacher CDI Reports by Family Language Status From Child Ages 24 to 36 Months (n = *85*)

	Outcome													
	Parent CDI reports								Teacher CDI reports					
	Model P1		Model P2		Model P3		Model P4		Model T1		Model T2		Model T3	
Fixed effects: $\gamma(SE)$														
Intercept	321.90***	(18.40)	280.96***	(17.94)	382.38***	(25.70)	383.26***	(24.59)	215.11***	(17.50)	234.4***	(21.32)	261.03***	(35.76)
Age			22.23***	(2.34)	29.20***	(3.45)	29.05***	(3.40)			11.70***	(3.25)	9.59†	(5.00)
Age^2											−1.96***	(0.56)	−1.46	(0.88)
Bilingual Status					−149.18***	(32.20)	−103.15**	(36.75)					−40.23	(44.33)
Bilingual Status × Age					−11.23*	(4.48)	−11.98**	(4.43)					4.21	(6.55)
Bilingual Status × Age^2													−0.92	(1.15)
Bilingual Status × Child Language Use (primarily Spanish)							−116.55**	(41.15)						
Bilingual Status × Child Language Use (Spanish & English)							−33.48	(45.02)						
Variance components: σ^2 (SE)														
Within person	17,478***	(2,850.45)	8,412.37***	(1,392.37)	7,959.61***	(1,350.96)	7,906.12***	(1,327.92)	12,156***	(2,000.23)	5,966.64***	(1,304.88)	6,007.29***	(1,309.50)
In initial status	17,455***	(4,684.18)	20,073***	(4,060.26)	13,602***	(3,134.77)	12,077***	(2,851.54)	18,001***	(4,173.21)	22,292***	(4,800.41)	21,762***	(4,689.37)
In rate of change											209.60*	(94.93)	196.46*	(93.87)
Covariance with initial status											−325.53	(501.84)	−312.43	(490.89)
Goodness-of-fit statistics														
−2LL	2,075.7		2,011.8		1,981.8		1,974.0		2,040.1		2,016.2		2,013.7	
AIC	2,081.7		2,019.8		1,993.8		1,990.0		2,046.1		2,030.2		2,033.7	

Note. CDI = MacArthur-Bates Communicative Development Inventory. ; −2LL = −2 log-likelihood statistic; AIC = Akaike information criterion.
†$p < .10$. *$p < .05$. **$p < .01$. ***$p < .001$.

trajectory (see Model T2). In other words, parent reports indicated a consistent increase in child vocabulary knowledge with increasing age, whereas teacher reports indicate a slowing growth pattern from child age 30 months.

Given that children from bilingual families varied in their use of Spanish and English with parents, we fit an additional model with child home language use as a predictor of parent CDI reports to further understand whether parent reports varied as a function of child language use. We created a series of dichotomous variables representing three groups: (1) children who primarily spoke Spanish, (2) children who spoke English and Spanish with parents, and (3) children who primarily spoke English. We grouped children who spoke a different language to each parent with those who spoke equal amounts of both languages to each parent as (a) very few children (n = 3) fell in the former group and (b) both these patterns indicated the use of both languages by children albeit in differing amounts to each parent. Children who primarily spoke English were the reference group. By including the interaction of these dichotomous variables with bilingual status we ensured that these estimates represented the effects of child language use solely for the group of bilingual families (coded as 1). For monolingual families (coded as 0) these terms would equal 0. Model P4 in Table 2 indicates that parent reports of children's English vocabulary use was significantly lower for children who were reported to speak primarily Spanish at home than children who were reported to speak primarily English at home. No difference was noted between the group of children who spoke Spanish and English and the group of bilingual children who spoke primarily English. Child Spanish–English language use did not have a significant effect on growth (models not shown). Also, child Spanish–English language use was not a significant predictor of teacher reports (models not shown).

Based on parent reports (see Figure 1), children from monolingual English-speaking families (solid black line) were reported to have higher productive vocabularies at child age 24 months and to have steeper rates of growth over time than children from bilingual families (two dashed black lines). No such difference between children from monolingual and bilingual families was noted based on teacher reports (solid gray line). Also, parents reported higher productive vocabularies than teachers for children from monolingual families across toddlerhood (the solid black and gray lines). Parents of bilingual children who spoke mostly English at home also reported higher productive vocabularies than teachers across toddlerhood (long dashed black and solid gray lines). However, except at age 36 months, teachers reported higher productive vocabularies than parents for bilingual children who were reported to speak mostly Spanish with parents (short dashed black and solid gray lines).

Do Multiple Reporters—Parents and Teachers—Provide a More Comprehensive Estimation of English Vocabulary Knowledge in Comparison to Single Parent Reports for Children From Monolingual and Bilingual Families Across Toddlerhood? If So, Then Does the Contribution of Teacher Reports Differ for Children From Bilingual Families From That of Monolingual Families Across Toddlerhood?

Multilevel models of change were fit to the composite parent–teacher CDI scores. The taxonomy of these models is presented in Table 3 and the best fitting and most parsimonious model (Model C4) is illustrated in Figure 2 (light gray solid and dashed lines). Here, too, a curvilinear trajectory was found to be the best fitting functional form. In addition, children from monolingual and bilingual families differed significantly in their productive vocabularies only at child age 30 months; no significant difference was noted in their growth rates. Child Spanish–English language use was not a significant predictor of parent–teacher composite reports (models not shown).

In Figure 2, for ease of illustrating rater differences the same groups of children (monolingual

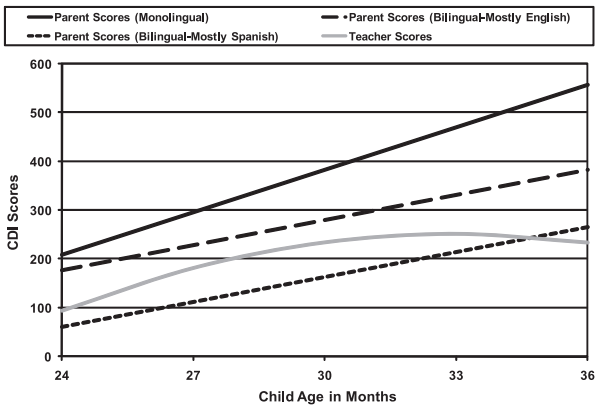

Figure 1. Average growth in children's productive vocabularies as reported by parents and teachers between child ages 24 and 36 months for children from monolingual families and for children from bilingual families (n = 85). CDI = MacArthur-Bates Communicative Development Inventory.

Table 3
Taxonomy of Fitted Multilevel Models of Change Predicting Children's Productive Vocabularies Based on Parent–Teacher Composite CDI Reports by Family Language Status From Child Ages 24 to 36 Months (n = 85)

	Outcome			
	Composite CDI reports			
	Model C1	Model C2	Model C3	Model C4
Fixed effects: γ (*SE*)				
Intercept	388.00*** (17.71)	378.94*** (20.98)	438.41*** (32.83)	464.23*** (29.11)
Age		19.99*** (2.55)	20.82*** (3.74)	20.32*** (2.51)
Age^2		−1.32* (0.57)	−0.14 (0.91)	−1.32* (0.57)
Bilingual Status			−89.86* (40.85)	−129.95*** (33.13)
Bilingual Status × Age			−0.20 (5.00)	
Bilingual Status × Age^2			−1.87 (1.16)	
Variance components: σ^2 (*SE*)				
Within person	15,604*** (2,606.85)	8,824.63*** (1,474.52)	8,655.06*** (1,461.61)	8,957.24*** (1,518.02)
In initial status	16,524*** (4,482.37)	19,267*** (4,038.55)	15,226*** (3,452.24)	15,088*** (3,487.09)
Goodness-of-fit statistics				
−2LL	2,060.8	2,013.5	1,996.8	1,999.6
AIC	2,066.8	2,023.5	2,012.8	2,011.6

Note. CDI = MacArthur-Bates Communicative Development Inventory; −2LL = −2 log-likelihood; AIC = Akaike information criterion.
*p < .05. **p < .01. ***p < .001.

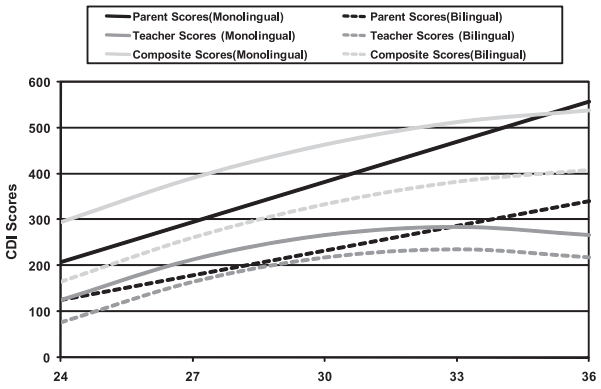

Figure 2. Average growth in children's productive vocabularies as reported by parents, teachers, and parent–teacher composite reports between child ages 24 and 36 months for children from monolingual families and for children from bilingual families (n = 85). CDI = MacArthur-Bates Communicative Development Inventory.

and bilingual children) have been illustrated for parent, teacher, and composite reports. It should be noted that differences between children from monolingual and bilingual families based on teacher reports is not significant. Of interest, to address the second research question is the difference between the parent report trajectories and the parent–teacher composite trajectories. This difference indicates the unique contribution of teacher reports to children's productive vocabularies that is not captured by the parent reports. Teachers report a greater number of unique words beyond age 27 months for children from bilingual families than for children from monolingual families; these differences are significant at child ages 30 months, $t(30.3) = -2.61$, $p < .01$; 33 months, $t(20.4) = -3.47$, $p < .001$; and 36 months, $t(43.3) = -2.10$, $p < .05$. No significant difference was noted at the younger ages of 24 and 27 months, $t(22) = 0.29$, $p = .78$, and $t(23) = -0.97$, $p = .34$, respectively. Additional examination by child language use indicated that at all time points teachers on average report a greater number of unique words for children from bilingual families who mostly speak Spanish with parents than for children from bilingual families who mostly speak English with parents and children from monolingual families (effects not illustrated).

In addition, an examination of the words reported by both parent and teachers as a percentage of the total composite scores presented in Table 4 indicates that on average there was greater agreement between parent and teacher reports for children from monolingual families than for children from bilingual families at each time point. As expected, the unique contribution of individual reporters (parents or teachers) was on average higher for children from bilingual families relative to children from monolingual families. Also, with increasing child age and consequently increasing

Table 4
Correlation Coefficients Between Parent and Teacher CDI Reports and Descriptive Statistics for Percent Agreement of Words Between Parent and Teacher Reports for Children From Bilingual and Monolingual Families at Child Ages 24, 27, 30, 33, and 36 Months

		24 months	27 months	30 months	33 months	36 months
Bilingual	*n*	12[a]	15	23	13[b]	31
Parent–teacher correlation		.20	.42	.48*	.01	.29
% agreement	*M* (*SD*)	22.9 (7.8)	26.5 (16.6)	35.1 (20.2)	32.9 (15.6)	33.8 (19.3)
Monolingual	*n*	9[a]	10	12	11	15
Parent–teacher correlation		.64[†]	.52	.74**	.08	.22
% agreement	*M* (*SD*)	29.1 (18.9)	38.6 (27.2)	42.9 (23.2)	43.1 (23.8)	38.9 (25.7)
All children	*n*	21	25	35	24	46
Parent–teacher correlation		.55*	.47*	.51**	−.12	.31*
% agreement	*M* (*SD*)	25.7 (14.0)	31.3 (21.8)	37.8 (21.3)	36.9 (19.5)	35.4 (21.5)

Note. PPVT–III = Peabody Picture Vocabulary Test–Third Edition; WLPB–R = Woodcock Language Proficiency Battery–Revised; CDI = MacArthur-Bates Communicative Development Inventory.
[a]Two monolingual children and one bilingual child were extreme outliers and were excluded. The correlation coefficient including them was .06 for the bilingual group, .13 for the monolingual group, and .17 for the full sample. [b]Four bilingual children who were extreme outliers were excluded. The correlation coefficient including them was −.55 for the bilingual group and −.23 for the full sample.
[†]$p < .10$. *$p < .05$. **$p < .01$.

communicative ability, there was an increase in the percent agreement between parent and teacher reports. For both groups, percent agreement increased from child ages 24 to 30 months after which agreement somewhat stabilized. Yet, for both groups of children percent agreement, on average, was less than 50% indicating that more than half to about two thirds of the words on the composite reports were uniquely provided by one or the other reporter.

Despite the somewhat low levels of percent agreement, parent and teacher reports for the full sample are significantly and positively associated at all time points except at child age 33 months (see Table 4). Given the small sample sizes for children from bilingual and monolingual families we focus our discussion of the correlation analysis on the full sample. The magnitude of the association between parent and teacher reports is moderate at the younger child ages, that is, 24, 27, and 30 months, whereas there is no significant association between parent and teacher reports at child age 33 months and the association at 36 months is low-moderate. The emerging pattern is one of relatively stronger correlations at younger child ages relative to older child ages.

Although these findings suggest that teacher reports in combination with parent reports may provide a fuller picture of young children's productive vocabularies, it is important to consider the validity of these composite reports before arriving at any conclusion about the utility of parent–teacher composite reports.

Are Parent Reports, Teacher Reports, and Parent–Teacher Composite Reports Valid Estimations of English Vocabulary Knowledge for Children From Bilingual and Monolingual Families When Compared to Direct Vocabulary Assessments (PPVT–III and WLPB–R) at Child Ages 30 and 36 Months?

Given that the use of the CDI with low-income families has been controversial (Akers et al., 2005; Roberts, Burchinal, & Durham, 1999) and particularly as Spanish–English parents reported about children's productive vocabularies in a non-native language we evaluated the validity of the parent reports in addition to the validity of teacher reports and parent–teacher composite reports.

The correlation coefficients presented in Table 5 indicate that parent reports were significantly associated with children's productive (WLPB–R) and receptive (PPVT–III) vocabularies at concurrent time points. Parent–teacher composite reports were significantly associated with children's WLPB–R and PPVT–III scores at child age 36 month. Teacher reports were not significantly associated with the WLPB–R and PPVT–III scores.

Tables 6 and 7 present a taxonomy of general linear mixed regression models predicting for children's performance on the Picture Vocabulary subtest of the WLPB–R and PPVT–III, respectively, by CDI reports obtained at concurrent time points, that is, child ages 30 and 36 months. Model 2 in Tables 6 and 7 indicate that children from bilingual families on average had lower scores on the WLPB–R and PPVT–III, respectively, than children

Table 5
Correlation Coefficients Between Parent, Teacher, and Composite CDI Reported Scores at Child Ages 30 and 36 Months With Children's Concurrent Performance on the Picture Vocabulary Subtest of the WLPB–R and the PPVT–III

	30 months (n = 30)		36 months (n = 40)	
	WLPB–R	PPVT–III	WLPB–R	PPVT–III
Parent CDI report	.46**	.38*	.52**	.47**
Teacher CDI report	.07	.00	.09	.11
Composite CDI report	.33†	.24	.38*	.34*

Note. PPVT–III = Peabody Picture Vocabulary Test–Third Edition; WLPB–R = Woodcock Language Proficiency Battery–Revised; CDI = MacArthur-Bates Communicative Development Inventory.
$^{\dagger}p < .10$. *$p < .05$. **$p < .01$.

from monolingual families. In addition, of the children from bilingual families, those who were reported to speak mostly Spanish had lower scores on the WLPB–R than those who were reported to speak mostly English. This finding parallels the finding for the parent CDI reports and lends further credibility to the parent CDI reports. Home language status and child English–Spanish language use together account for a significant 47% and 42% of the variation between children at 30 months in WLPB–R scores and PPVT–III scores, respectively.

Furthermore, parent CDI reports were significantly associated with WLPB–R scores even after controlling for child age, home language status, and child Spanish–English use (Model 4 in Table 6). However, parent CDI reports were not significantly associated with PPVT–III scores once child age, home language status, and child language use were controlled for (Model 4 in Table 7). Given that the CDI reports are intended to assess children's *productive* vocabulary knowledge, the stronger association between CDI reports and the WLPB–R corroborates that low-income parents in fact report on children's productive vocabulary use. Moreover, the lack of a significant interaction between parent CDI reports and home language status (model not presented) indicates that there is no difference in the association of monolingual and bilingual parents CDI reports with children's WLPB–R scores. This provides support for the use of CDI checklists with low-income bilingual parents reporting about their children's productive use of a non-native language, English, at least at child ages 30 and 36 months.

Teacher reports (Models 5 and 6 in Tables 6 and 7, respectively), on the other hand, were not significantly associated with children's performance on the WLPB–R and PPVT–III before and after accounting for home language status and child Spanish–English use. This indicates that teacher reports alone do not provide a valid representation of young children's productive vocabulary use.

The parent–teacher composite reports, like the parent reports, were significantly associated with WLPB–R scores (Model 8 in Table 6), but not with PPVT–III scores (Model 8 in Table 7). This indicates that like the parent reports, the parent–teacher composite reports provide valid estimations of young children's *productive* vocabularies even after accounting for child age, home language status, and child language use. Note that we also tried models using just the words reported by both parent and teachers as predictors to check whether this stringent estimate of children's vocabulary would be a more valid predictor of children's WLPB–R and PPVT–III scores than parent scores. The common words did not significantly relate to children's direct vocabulary assessments.

What Is the Utility of Parent–Teacher Composite Reports? In Other Words, Are Parent–Teacher Composite Reports as Strongly or More Strongly Associated With Children's Direct Vocabulary Assessments (PPVT–III and WLPB–R) at Child Ages 30 and 36 Months Than the Single Parent Report Measure?

The goodness-of-fit statistics presented in Table 6 indicate that parent reports (Model 3) provide a slightly better fit when predicting WLPB–R scores in comparison to the composite reports (Model 7). Also, child age is no longer a significant predictor of WLPB–R scores when parent reports are included in the model but continue to be a significant predictor when composite reports are included in the model. This indicates that parent reports provide a developmental snapshot of children's emerging productive vocabularies over and beyond that captured by child age. Finally, the magnitudes of the correlation coefficients presented in Table 5 indicate that parent reports are more strongly corre-

Table 6

Taxonomy of Fitted General Linear Mixed Models Predicting Children's Productive Vocabulary (Picture Vocabulary Subtest of the WLPB–R) at Ages 30 and 36 Months by Parent, Teacher, and Parent–Teacher Composite Reports Obtained at Child Ages 30 and 36 Months After Controlling for Family Language Status and Child Age (n = 57)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Fixed effects: γ (*SE*)								
Intercept	10.85*** (0.77)	13.73*** (0.97)	7.01***(1.19)	10.08*** (1.74)	9.41*** (1.03)	12.63*** (1.20)	7.05*** (1.43)	10.28*** (1.77)
Age	0.50** (0.14)	0.45** (0.13)	0.24 (0.15)	0.27† (0.15)	0.53** (0.13)	0.47** (0.12)	0.37* (0.14)	0.36* (0.13)
Bilingual status		−2.40* (1.13)		−0.91 (1.24)		−2.07† (1.16)		−1.28 (1.20)
Bilingual Status × Child Language Use (primarily Spanish)		−4.70** (1.36)		−4.44** (1.29)		−4.78** (1.37)		−4.85*** (1.33)
Bilingual Status × Child Language Use (English and Spanish)		−1.43 (1.38)		−1.48 (1.30)		−1.82 (1.41)		−1.78 (1.35)
CDI parent reports			0.01** (0.003)	0.01* (0.003)				
CDI teacher reports					0.01† (0.003)	0.004 (0.002)		
CDI composite reports							0.01* (0.003)	0.007* (0.003)
Variance components: σ^2 (*SE*)								
Within-person variance	8.13** (2.69)	7.62*** (2.36)	9.61** (3.14)	8.23*** (2.54)	6.10** (2.30)	6.36** (2.21)	7.02*** (2.39)	6.69*** (2.13)
Initial status	10.50** (3.60)	5.59* (2.58)	5.07† (3.24)	3.74† (3.30)	12.45***(3.79)	6.79** (2.76)	9.45** (3.26)	5.71** (3.51)
Goodness-of-fit statistics								
−2LL	398.4	376.8	385.0	371.1	395.3	375.0	389.6	371.8
AIC	406.4	390.8	395.0	387.1	405.3	391.0	399.6	387.8

Note. WLPB–R = Woodcock Language Proficiency Battery–Revised; CDI = MacArthur-Bates Communicative Development Inventory; −2LL = −2 log-likelihood statistic; AIC = Akaike information criterion.
†$p < .10$. *$p < .05$. **$p < .01$. ***$p < .001$.

Table 7
Taxonomy of Fitted General Linear Mixed Models PPVT–III at Ages 30 and 36 Months by Parent, Teacher, and Parent–Teacher Composite Reports Obtained at Child Ages 30 and 36 Months After Controlling for Family Language Status and Child Age (n = *57*)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Fixed effects: γ (*SE*)								
Intercept	3.40***	4.23***	2.56***	3.61***	3.35***	4.24***	2.76***	3.92***
	(0.17)	(0.23)	(0.27)	(0.41)	(0.24)	(0.28)	(0.34)	(0.42)
Age	0.10**	0.10**	0.05	0.07*	0.10**	0.10**	0.08*	0.09*
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Bilingual status		−1.03***		−0.77*		−1.03***		−0.93**
		(0.27)		(0.30)		(0.27)		(0.29)
Bilingual status × Child Language Use (primarily Spanish)		−0.53		−0.49		−0.53		−0.55†
		(0.32)		(0.32)		(0.32)		(0.32)
Bilingual Status × Child Language Use (English and Spanish)		0.02		−0.01		0.03		−0.01
		(0.33)		(0.32)		(0.33)		(0.33)
CDI parent reports			0.003**	0.001†				
			(0.001)	(0.001)				
CDI teacher reports					0.0002	−0.000		
					(0.001)	(0.001)		
CDI composite reports							0.002*	0.001
							(0.001)	(0.001)
Variance components: σ^2 (*SE*)								
Within-person variance	0.32**	0.31**	0.31**	0.29**	0.32**	0.31**	0.34**	0.31**
	(0.11)	(0.10)	(0.10)	(0.10)	(0.11)	(0.10)	(0.12)	(0.10)
Initial status statistics	0.71***	0.41**	0.52***	0.40***	0.70***	0.41**	0.59***	0.40***
	(0.19)	(0.14)	(0.16)	(0.13)	(0.19)	(0.14)	(0.18)	(0.14)
Goodness-of-fit								
−2LL	192.2	170.8	178.8	167.6	192.1	170.8	187.5	173.1
AIC	200.2	184.8	188.8	183.6	202.1	186.8	197.5	185.1

Note. PPVT = Peabody Picture Vocabulary Test–Third Edition; CDI = MacArthur-Bates Communicative Development Inventory; −2LL = −2 log-likelihood statistic; AIC = Akaike information criterion.
†$p < .10$. *$p < .05$. **$p < .01$. ***$p < .001$.

lated with direct vocabulary assessments than parent–teacher composite reports. All of this suggests that although parent–teacher composite reports significantly relate to the direct assessments of children's *productive* vocabularies, the composite reports may have limited utility in comparison to parent reports.

Discussion

The longitudinal design of this study allowed us to address questions about growth in English vocabulary development for young children from low-income monolingual and bilingual families. First, using individual growth modeling, we found a steady and uniform increase in English productive vocabulary knowledge, irrespective of home language status, for all children from ages 24 to 36 months based on parent reports. As expected, children from English-speaking homes not only had higher vocabularies at age 30 months, but they also experienced faster rates of growth in vocabulary development across toddlerhood than children from bilingual homes. This amounted to an average difference of 31 words at child age 24 months and 175 words at child age 36 months between children from monolingual families and children from bilingual families who mostly spoke English with their parents. The average difference between children from monolingual families and children from bilingual families who mostly spoke Spanish with their parents was about 148 words at child age 24 months and 292 words at child age 36 months. This finding is in keeping with studies that report that vocabulary differences manifest early and tend to increase over time (Hart & Risley, 1995) and that the productive vocabulary of English language learners lags in comparison to their native English-speaking peers (Baker et al., 1998). In addition, we also found that among the group of bilingual children those who were reported to speak mostly Spanish had lower scores on the parent reports than children who were reported to speak mostly English. This resulted in a difference of about 117 words between these two groups and underscores the importance of accounting for differences in bilingual children's use of Spanish and

English in addition to their bilingual status. It is worth noting that the vocabulary lag noted in the present article is specific to English. If vocabulary development in both English and Spanish were examined, it is altogether likely that the vocabulary lag would be diminished or indistinguishable, given that prior research has demonstrated that bilingual children's vocabularies are likely to be distributed across their two languages (Pearson, Fernández, & Oller, 1995). However, our focus in the present study is on English, a language in which verbal facility is crucial for later academic achievement in U.S. schools.

A second major finding of this study is that the developmental trajectory based on teacher reports markedly differs from that based on parent reports. Children's productive vocabularies as reported by teachers demonstrated a curvilinear pattern of slowing growth for children from both monolingual and bilingual families. Hence, unlike the trajectories based on parent reports, the trajectory based on teacher reports indicated growth in the initial months, followed by a gradual plateauing of growth beginning from child age 30 months. These findings may reflect the fact that teachers are interacting with individual children as part of a group, possibly in more restricted contexts, and potentially for fewer contact hours, than are parents and therefore are not able to provide a comprehensive list of words used by individual children, particularly when children demonstrate greater communicative ability with increasing age. Teacher reports also did not significantly distinguish between the productive vocabularies of children from monolingual and bilingual families. It follows then that teacher reports cannot be relied upon in isolation to provide a developmental understanding of young children's productive use of vocabulary.

Of greater importance to the present investigation was whether teacher reports help supplement parent reports to provide a fuller picture about children's English vocabulary development, especially for children from bilingual families. As illustrated in Figure 2, the difference between the parent report trajectories and composite report trajectories suggests that teachers report words that are not reported by parents, thus lending a unique contribution to the estimation of children's productive vocabularies. Moreover, the unique teacher contributions to parent reports were significantly greater for children from bilingual families than for children from monolingual English-speaking families at child ages 30, 33, and 36 months. At the earlier ages—24 and 27 months—no such difference was noted in teacher contributions to parent reports between children from bilingual and monolingual families, perhaps because bilingual parents were able to provide a more complete account of children's word use at these younger ages when children were less communicative relative to the later months. Unique teacher contributions were also greater for bilingual children who spoke mostly Spanish at home. This finding provides further indirect evidence that parents are indeed reporting on words they hear their children use.

For children from English-speaking homes, at all child ages, parent reports exceeded teacher reports, whereas this pattern was more mixed for children from bilingual homes. For the latter group, on average, parents and teachers reported somewhat similar number of words in the early months, and parents reported a greater number of words at child ages 33 and 36 months. In addition, for both groups together, teacher reports were found to be positively and significantly associated with parent reports at all time points except child age 33 months.

These findings suggest that the contributions of teacher reports might be useful in arriving at a more complete picture of young children's developing productive vocabularies. Our validity analysis provided mixed support for this conclusion. Parent–teacher composite reports, like the parent reports were significantly related to children's concurrent, direct assessments of productive vocabulary (WLPB–R) at child ages 30 and 36 months even after controlling for child age, home language status, and child English–Spanish use. However, the goodness-of-fit statistics indicated that parent reports provided a slightly better fit to the models predicting for WLPB–R scores and the correlation analysis indicated that parent reports were more strongly associated with children's direct assessments of vocabulary than were composite reports. The differences in model fit of the parent reports and the composite reports are small, and given the small sample size for the validity analysis, this warrants further research. In sum, although parent reports in combination with teacher reports provide a higher estimation of children's productive vocabulary development, the findings underscore the importance of examining the validity of multiple reports in order to determine whether ''more'' is in fact ''better.'' Evidence for validity is crucial to provide sound recommendations to researchers and clinicians.

We also noted that the percent agreement in the words reported by parents and teachers increased

from child ages 24 to 30 months and then plateaued, indicating that with increasing child age and consequently increasing communicative ability the provision of unique words provided by reporters declines. This contradicts the findings of De Houwer et al. (2005) who found increased unique contributions of multiple reporters for children of greater communicative ability. Parents are required to report for the most part on a single child, whereas teachers may report on multiple children in their classroom. As a result, the CDI long form for toddlers comprising a substantial 680 items poses a sizable burden on teachers, particularly if teachers complete the forms on multiple occasions across time. Given that with increasing age children tend to demonstrate greater communicative ability, reporting on individual children's specific vocabulary use from a list of 680 words may prove to be a challenging task for teachers. Perhaps the use of the CDI short forms for toddlers, comprising only 100 items, may impose a less onerous time burden on teachers, particularly for repeated measurements, and consequently help provide more valid representations of young children's developing, productive vocabularies. Also at issue may be the nature of items comprising the CDI toddler forms, which may not be adequately representative of vocabulary used in classrooms that teachers are more likely to hear children use. All of this perhaps adversely affects the validity of teacher reports. The significant, positive and moderate to low-moderate associations between parent and teacher reports indicate that teachers were to some extent successful in ranking children based on their productive vocabularies that were in accordance with parent reports. Furthermore, an exploratory examination of individual teachers reporting on several children in their classroom indicates that teachers do distinguish among same-age children in their classroom rather than reporting, for example, on an internalized, prototypical 2-year-old.

Although, the present study represents an important first step in understanding the utility and validity of combining parent reports with teacher reports, some key limitations remain. First, we were not able to successfully track which classroom teacher completed the CDI reports at each time point and when children changed classrooms or teachers (if at all). Second, given our focus on EHS and HS teachers in New England, additional research with EHS and HS teachers in other regions and with other early childhood educators is needed to evaluate the generalizability of our findings.

Finally, a positive finding is that low-income parents and Spanish- or Spanish/English-speaking parents are able to provide valid estimations of their children's English productive vocabularies at child ages 30 and 36 months. The magnitudes of these correlations are moderate to high-moderate and although not as high as those reported for children from middle-income English-speaking or Spanish–English bilingual families, are in the acceptable range for establishing validity (for a summary of validity studies, see Fenson et al., 2007, p. 106). Of particular interest is the finding that parent reports were more strongly associated with children's productive vocabulary knowledge (WLPB–R) than with children's receptive vocabulary knowledge (PPVT–III), thus indicating that low-income monolingual and bilingual parents are able to discriminate between the words their children say and the words their children understand. In addition, first, the significant differences between parent CDI reports based on home language status and child Spanish–English use were mirrored in the findings for the WLPB–R and PPVT–III scores, and second, parent reports significantly related to WLPB-R scores even after controlling for the effects of home language status and child Spanish–English use. These two findings provide additional evidence for the appropriateness of the CDI: Word and Sentences forms for use with low-income monolingual and bilingual families.

Moreover, the CDI reports captured a wide range of vocabulary as is reported for normally developing monolingual children (Feldman et al., 2000). The average vocabularies for our monolingual sample are substantially lower than those reported for the norming sample (Fenson et al., 1994) but are more in line with the average vocabularies reported by Feldman et al. (2000), who sampled a more socioeconomically diverse group of families than was represented in the norming sample.

Conclusion

The vocabulary lag demonstrated by children from low-income bilingual homes in comparison to children from low-income monolingual homes is of great concern, given the robust associations between early vocabulary knowledge and later academic achievement. Regular tracking of vocabulary is thus much needed to help teachers and programs better understand what services to provide. This study indicates that the CDI: Words and Sentences

long forms are useful through at least age 36 months for the English only and Spanish–English bilingual populations served by EHS and HS programs.

Our work indicates that low-income parents are capable of reporting on their children's productive use of words at child ages 30 and 36 months, even when parents are non-native speakers of English and have different amounts of exposure to their children's use of English as demonstrated by the variability in home language use. However, the lack of CDI normative data for children from low-income monolingual and bilingual homes presents a considerable limitation.

Even though teacher reports were significantly associated with parent reports and parent reports alone seemed to underestimate children's vocabulary knowledge, we failed to provide conclusive evidence for the utility of teacher contributions to supplement parent reports to arrive at more accurate estimates of young children's productive vocabulary use. Two next steps that are underway will help shed more light on this issue. First, the analysis of videotaped interactions between parents and children will provide an additional vocabulary measure with which to compare teacher contributions. The advantage of videotaped parent–child interactions is that unlike the standardized direct assessments (WLPB–R and PPVT–III), they provide a spontaneous measure of children's language use and they do not require children to interact with unfamiliar adults. Also, spontaneous measures are preferable criteria against which to examine the validity of parent reports, as the WLPB–R and PPVT–III were designed for use with monolingual English speakers. Second, the use of the CDI toddler short forms with parents and teachers in our current endeavor will help elucidate whether reducing the burden on teachers by using the short forms increases their accuracy in reporting about the productive vocabulary use of children in their classroom. It will also help us to understand whether the use of the short forms with parents continues to provide valid estimations of young children's productive vocabulary use by low-income monolingual and bilingual parents.

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Appendix A

Table A1

Sample Mean, Standard Deviation, and Statistics for Testing Differences in Selected Background Variables Between Children Who Entered the Study at 24 Months (n = *39*), *30 Months* (n = *35*), *and 36 Months* (n = *38*)

	M (*SD*) Study entry			
Variable	24 months	30 months	36 months	*F* statistic (*p* value)
Mother's education	13.03 (2.95)	13.31 (1.89)	12.89 (3.01)	0.23 (.79)
Father's education	11.72 (2.96)	12.08 (3.05)	12.70 (4.22)	0.61 (.55)
Income	2.81 (1.83)	2.50 (1.33)	3.23 (2.43)	1.25 (.29)
Mother's language use to child[a]	2.05 (0.93)	1.94 (0.84)	1.78 (0.92)	0.85 (.43)
Father's language use to child[a]	2.06 (0.95)	1.85 (0.92)	1.76 (0.97)	0.89 (.41)
Child's language use to mother[a]	2.32 (0.91)	2.23 (0.88)	2.35 (0.86)	0.19 (.83)
Child's language use to father[a]	2.35 (0.91)	2.17 (0.92)	2.26 (0.93)	0.29 (.75)

Note. Parent interview data are not available for 6 children.
[a]1 = only or mostly Spanish, 2 = English and Spanish, and 3 = only or mostly English.

Table A2

Sample Mean, Standard Deviation, and Statistics for Testing Differences in Selected Background Variables Between Children Who Contributed One Wave of Data (n = *42*) *Versus Children Who Contributed Two or More Waves of Data* (n = *41*)

	M (*SD*)		
Variable	One wave	Two or more waves	*t*-statistic (*p* value)
Mother's education	13.43 (3.42)	13.20 (1.84)	0.39 (.70)
Father's education	12.58 (3.91)	11.50 (2.66)	1.29 (.20)
Income	3.31 (2.47)	2.62 (1.60)	1.47 (.15)
Mother's language use to child[a]	2.02 (0.94)	2.15 (0.86)	−0.63 (.53)
Father's language use to child[a]	1.82 (0.97)	2.17 (0.92)	−1.62 (.11)
Child's language use to mother[a]	2.44 (0.87)	2.41 (0.82)	2.95 (1.28)
Child's language use to father[a]	2.26 (0.92)	2.43 (0.81)	0.75 (.46)

Note: Parent interview data are not available for 2 children.
[a]1 = only or mostly Spanish, 2 = English and Spanish, and 3 = only or mostly English

Table A3

Sample Mean, Standard Deviation, and Statistics for Testing Differences in Selected Background Variables Between Children Who Had Matched Parent–Teacher Reports (n = *83*) *Versus Children Who Did Not Have Matched Parent–Teacher Reports and Were Not Included in the Present Study* (n = *17*)

	M (*SD*)		
Variable	Study participants	Non-participants	*t*-statistic (*p* value)
Mother's education	12.71 (2.62)	13.26 (2.73)	−0.77 (.44)
Father's education	12.42 (2.54)	12.08 (2.10)	0.32 (.75)
Income	2.56 (1.46)	2.94 (2.10)	−0.68 (.50)
Mother's language use to child[a]	1.82 (0.81)	2.13 (0.89)	−1.29 (.20)
Father's language use to child[a]	2.00 (1.00)	2.01 (0.96)	−0.05 (.96)
Child's language use to mother[a]	2.29 (0.85)	2.46 (0.83)	−0.73 (.47)
Child's language use to father[a]	2.45 (0.93)	2.38 (0.87)	0.26 (.80)

Notes. Parent interview data are not available for 4 children.
[a]1 = only or mostly Spanish, 2 = English and Spanish, and 3 = only or mostly English.

Appendix B

Model based on teacher Communicative Development Inventory (CDI) reports:

$$\text{Teacher CDI}_{it} = \left[\gamma_{00} + \gamma_{10}(\text{Child Age} - 30)_{it} + \gamma_{20}(\text{Child Age} - 30)_{it}^2\right] + \left[\zeta_{0i} + \zeta_{1i} + \varepsilon_{it}\right],$$

where

$$\varepsilon_{it} \sim N(0, \sigma_{\varepsilon}^2) \text{ and } \begin{bmatrix} \zeta_{oi} \\ \zeta_{1i} \end{bmatrix} \sim N\left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} \sigma_0^2 & \sigma_{01} \\ \sigma_{10} & \sigma_1^2 \end{bmatrix} \right)$$

The growth parameters γ_{00} and γ_{10} represent the average reported vocabulary for children at age 30 months by teachers and the average rate of growth from child age 24 to 36 months, respectively. The Level 1 residual term ϵ_{it} represents that portion of the ith child's vocabulary production at child age t that is not explained by child age. The Level 2 residual terms ζ_{0i} and ζ_{1i} represent the deviations of each child's growth parameters from its population average for initial status, γ_{00}, and for rate of growth, γ_{10}.

Model based on composite parent–teacher CDI reports:

$$\begin{aligned} \text{Composite CDI}_{it} = &\left[\gamma_{00} + \gamma_{10}(\text{Child Age-30})_{it}\right. \\ &\left.+\gamma_{20}(\text{Child Age-30})_{it}^2 + \gamma_{01}\text{Biling}_i\right] \\ &+ [\zeta_{0i} + \varepsilon_{it}] \end{aligned}$$

where

$$\varepsilon_{it} \sim N(0, \sigma_{\varepsilon}^2) \text{ and } [\zeta_{0i}] \sim N\big([0], \big[\sigma_0^2\big]\big)$$

The growth parameters γ_{00} and γ_{10} represents the average reported vocabulary for children at age 30 months based on parent–teacher composite reports and the average rate of growth from child ages 24 to 36 months, respectively. The parameter γ_{01} represents difference in elevation between children from monolingual and bilingual families. The interaction term for family language status and child age was not significant and hence not included in this model. The Level 1 residual term ϵ_{it} represents that portion of the ith child's vocabulary production at child age t that is not explained by child age. The Level 2 residual term ζ_{0i} represents the deviations of each child's growth parameters from its population average for initial status, γ_{00}. The residual term for rate of growth was not significant and hence not included in the model to arrive at a parsimonious model specification.