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24-Month-Old Children With Larger Oral Vocabularies Display Greater Academic and Behavioral Functioning at Kindergarten Entry

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Data were analyzed from a population-based, longitudinal sample of 8,650 U.S. children to (a) identify factors associated with or predictive of oral vocabulary size at 24 months of age and (b) evaluate whether oral vocabulary size is uniquely predictive of academic and behavioral functioning at kindergarten entry. Children from higher socioeconomic status households, females, and those experiencing higher quality parenting had larger oral vocabularies. Children born with very low birth weight or from households where the mother had health problems had smaller oral vocabularies. Even after extensive covariate adjustment, 24-month-old children with larger oral vocabularies displayed greater reading and mathematics achievement, increased behavioral self-regulation, and fewer externalizing and internalizing problem behaviors at kindergarten entry.

Children with greater academic and behavioral functioning at kindergarten entry often experience better educational and societal opportunities as they age (Duncan et al., 2007; Sabol & Pianta, 2012). For example, children entering kindergarten with greater reading and mathematics achievement are more likely to attend college and enroll in higher quality institutions. They are also more likely to own homes, have 401(k) savings, be married, and live in higher income neighborhoods as adults (Chetty et al., 2011). Identifying factors contributing to greater academic and behavioral functioning at kindergarten entry should help guide efforts to deliver early interventions to specific population subgroups at risk for lower school functioning (Hoff, 2013; Lesaux, 2012), and so reduce later achievement gaps and increase postsecondary education, employment, productivity, and long-term wages (e.g., Heckman & Masterov, 2007).

Oral vocabulary is a malleable factor repeatedly theorized to contribute to increased academic and behavioral functioning, and so might be targeted in early interventions (e.g., Dickinson, Golinkoff, & Hirsh-Pasek, 2010; Perfetti & Stafura, 2014; see Appendix S1 in the online Supporting Information for further discussion of oral vocabulary terminology). Oral vocabulary refers to the words children use when speaking or recognize when listening. At-risk children's oral vocabularies have been theorized to constitute a "first-order" causal factor that, if increased, may enhance their developmental trajectories (Dickinson et al., 2010; Lesaux, 2012).

Oral Vocabulary's Theorized Relation With Academic and Behavioral Functioning

Theoretically, at about 24 months of age, accelerating growth in children's lexicons overtaxes their

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protosyllabary (i.e., meaningless speech–motor patterns) and their use of word gestures (Levelt, Roelofs, & Meyer, 1999). To more effectively communicate, children are believed to rely increasingly on (a) phonemization, so that words begin to be represented by phonological segments, and (b) syntactization, in which lexical concepts begin to be grouped by categories and subcategories. Use of this dual-coding process, which is not necessarily contingent on the "vocabulary spurt" that itself may not occur for most children (Ganger & Brent, 2004) and can be explained by nonspecialized cognitive processes (McMurray, 2007), should allow young children to begin associating particular phonetic encodings and articulations with specific lexical representations, thereby facilitating acquisition and use of an oral vocabulary of increasingly greater size and complexity (Ouellette, 2006).

Acquiring a larger oral vocabulary should over time result in greater reading achievement (National Institute of Child Health and Human Development [NICHD] Early Child Care Research Network, 2005; Perfetti & Stafura, 2014; Walker, Greenwood, Hart, & Carta, 1994) by facilitating listening comprehension (Hoover & Gough, 1990) as well as decoding skills (Verhoeven, Leeuwe, & Vermeer, 2011). Children with larger oral vocabularies should more efficiently store words in their lexicons as smaller segments, helping to increase their phonological sensitivity and, thus, their understanding of the alphabetic principle and decoding (Silven, Poskiparta, Niemi, & Voeten, 2007). A larger oral vocabulary should also result in more efficient word identification (Perfetti & Hart, 2001), allowing children to better identify and understand partially decoded, irregular or novel, or orthographically complex words, and to infer spelling–sound relations (Mitchell & Brady, 2013). (Eventually, the relation between oral vocabulary and decoding becomes bidirectional, as independent reading results in new vocabulary acquisition.)

A larger oral vocabulary is also theorized to result in greater mathematics achievement (LeFevre et al., 2010). Children's initial understanding of the symbolic number system and its interrelations (e.g., number sequence, basic arithmetic and subtraction) is thought to rely on language-based verbal associations (e.g., Spelke & Tsivkin, 2001). Having a larger oral vocabulary should result in children's lexicons including more words and phrases representing abstract mathematical concepts, while also facilitating more complex understanding of these concepts. Children with larger oral vocabularies should more easily understand and solve mathematics problems presented in spoken or written stories, in part because of a better understanding of abstract terminology (Davidse, De Jong, & Bus, 2014). A relation between children's oral vocabularies and mathematics achievement may emerge prior to school entry (Purpura, Hume, Sims, & Lonigan, 2011).

A larger oral vocabulary should also result in greater behavioral functioning (e.g., Qi & Kaiser, 2004). Developmentally, this should occur as children begin using words to monitor and modify their own behavior (Eisenberg, Sadovsky, & Spinrad, 2005). Young children should begin to adopt their caregiver's regulatory speech, which increasingly emphasizes proactive or inhibitory rather than soothing behaviors (Winsler, Diaz, McCarthy, Atencio, & Chabay, 1999). Having a larger oral vocabulary should provide children with both greater symbolic representations of their internal states and better articulated frameworks for understanding their experiences, resulting in greater ability to organize and guide actions, regulate emotions, and self-verbalize problem-solving strategies (Cole, Armstrong, & Pemberton, 2010). Observable indicators of greater behavioral self-regulation, or "approaches to learning," include remaining attentive, persistent, flexible, engaged, and organized while completing classroom tasks (e.g., Li-Grining, Votruba-Drzal, Maldonado-Carreno, & Haas, 2010). Children's language abilities and behavioral self-regulation positively correlate as early as 24 months of age (Vaughn, Kopp, & Krakow, 1984).

A larger oral vocabulary should also facilitate children's understanding and communication with adults and peers (Cole et al., 2010). Conversely, children with smaller oral vocabularies should display more frequent externalizing or internalizing problem behaviors as they experience greater frustration and anger, lack of control of their environment, peer rejection, task avoidance, and withdrawal (Menting, Van Lier, & Koot, 2010). Having a smaller oral vocabulary positively covaries with greater avoidance and acting out behaviors in children as young as 24 months of age (Rescorla, Ross, & McClure, 2007).

Methodological and Substantive Limitations of Extant Research

Currently, however, the extant work's methodological and substantive limitations constrain empirically derived conclusions as to oral vocabulary's theorized importance for children's academic and behavioral functioning generally and as a specific target of early intervention for at-risk populations.

For example, the National Early Literacy Panel (NELP; 2008) identified 11 factors considered predictive of conventional literacy and concluded that five were "moderately correlated with at least one measure of later literacy achievement but either did not maintain this predictive power when other important contextual variables were accounted for or have not yet been evaluated by researchers in this way" (p. viii). One of these five factors was oral language, including vocabulary. The NELP (2008) suggested that future research evaluate the contribution of these factors.

To date, "surprisingly little" research has been conducted with preschool-aged children, with most studies relying on very small clinical samples (Horwitz et al., 2003, p. 932). Hart and Risley's (1995) seminal study analyzed data from a longitudinal sample of 42 families, including only 6 families representing the lowest socioeconomic status (SES) class. Pan, Rowe, Singer, and Snow (2005) characterized data from these 6 families as constituting "nearly the entirety of what we know" about vocabulary gaps by very young children from low-income families (p. 764). Fernald, Marchman, and Weisleder's (2013) recent study investigating vocabulary gaps at 18 and 24 months of age between children from high- and low-SES families was based on a sample of 48 children. Use of small samples limits generalizability to the larger, heterogeneous U.S. population. This is a limitation of studies analyzing even larger convenience samples (e.g., NICHD Early Child Care Research Network, 2005: Storch & Whitehurst, 2002). Knowledge is also limited about the age of onset and risk factors for vocabulary gaps for population subgroups that, in addition to children from low-SES families (Fernald et al., 2013) and racial or ethnic minorities (Farkas & Beron, 2004), may also be at risk. Associations with other modifiable factors (e.g., parenting, maternal mental health) have yet to be comprehensively examined. Early screening, monitoring, and intervention efforts would be better targeted if guided by findings from large-scale, epidemiological-type studies identifying the sociodemographic, gestational and birth, and family risk and resilience factors most strongly associated with early and meaningful differences in children's oral vocabularies. Many of these factors are known to be associated with or predictive of children's later cognitive, academic, and behavioral functioning (Lynch, 2011). Yet their specific associations with early vocabulary gaps are less clear.

Small convenience samples also limit the field's understanding of whether other factors explain the relation between oral vocabulary size and children's academic and behavioral functioning. For example, whether general cognitive functioning explains the relation between oral vocabulary and children's academic achievement has yet to be firmly established (Rescorla et al., 2007). Although a predictive relation between oral vocabulary size and reading achievement has been repeatedly observed (e.g., NICHD Early Child Care Research Network, 2005; Storch & Whitehurst, 2002; Walker et al., 1994; see Sénéchal, Ouellette, & Rodney, 2006, for a review), as well as comorbidity of language and reading disability (see Pennington & Bishop, 2009, for a review), evidence as to whether the relation is potentially causal is unclear due to the currently limited and mixed evidence (NELP, 2008; Ouellette, 2006; Schatschneider, Fletcher, Francis, Carlson, & Foorman, 2004). To what extent toddler- and preschool-aged children's oral vocabularies predict their later mathematics achievement or, separately, their behavioral functioning has yet to be comprehensively evaluated using population-based data. The extant studies almost entirely investigate single-domain pathways between oral vocabulary and (a) reading achievement, *or* (b) mathematics achievement, *or* (c) behavioral functioning instead of estimating multiple domain pathways simultaneously, particularly as children make the major transition to school (see Appendix S2 for further discussion of existing work's limitations).

Potential Confounds of the Theorized Relation Between Oral Vocabulary and Academic and Behavioral Functioning

Rigorously evaluating the extent to which 24-month-old children's oral vocabularies uniquely predict their academic and behavioral functioning by kindergarten requires extensive statistical control for many potential confounds. Evidence of oral vocabulary's predictive relations following this control would address identified limitations in the field's knowledge base (NELP, 2008), provide stronger support for each relation's potential causality (Hart & Risley, 1995), and empirically evaluate the merits of calls for greater emphasis on oral vocabulary and other language-based competencies in early intervention efforts (Dickinson et al., 2010; Hoff, 2013; Lesaux, 2012). To this end, we analyzed population-based data collected through a non-experimental panel design to evaluate evidence for potential causal relations between 24-month-old children's oral vocabularies and their academic and behavioral functioning at kindergarten entry.

We did so in two ways. First, we investigated whether 24-month-old children's oral vocabularies predicted their academic and behavioral functioning at 60 months of age, establishing temporal precedence. Second, we examined whether 24-month-old children's oral vocabularies continued to predict their academic and behavioral functioning at 60 months of age following extensive statistical control of many factors previously identified as potential confounds (e.g., general cognitive functioning, prior behavioral functioning), reducing the likelihood that any observed predictive relations between earlier oral vocabulary size and later academic and behavioral functioning were spurious.

Potential confounding factors of a relation between 24-month-old children's oral vocabularies and their later academic and behavioral functioning may be grouped into several types of factors, each previously established as predictive of academic and/or behavioral functioning. The first group includes sociodemographic characteristics of families including SES, race or ethnicity, maternal age, and parental marital status. Low SES in particular may result in less cognitively stimulating and higher stress environments that constrain young children's academic and behavioral growth (McLoyd, 1998). Low SES is strongly associated with non-White race or ethnicity, young maternal age, and being a single parent (DeNavas-Walt, Proctor, & Smith, 2013).

The second group of confounds are gestational and birth characteristics, including low or very low birth weight, multiple gestation, and medical risks and complications during pregnancy and at delivery. For instance, being born at low or very low birth weight (for which twins and higher order multiples have heightened risk) may result in neurodevelopmental impairments in behavioral self-regulation (Klebanov, Brooks-Gunn, & McCormick, 1994), general cognitive functioning (Hack, Klein, & Taylor, 1995), and academic achievement (Lynch, 2011). Medical risks during pregnancy (e.g., maternal substance use), and complications of pregnancy (e.g., gestational diabetes) and delivery (e.g., prolonged labor) are associated with later developmental delays (e.g., Anthopolos, Edwards, & Miranda, 2013).

Parenting and the quality of the home environment constitute a third group of potential confounds, with family stress and investment potentially explaining the effects of SES on children's development (Guo & Harris, 2000). For instance, young children whose parents are warm and supportive, set consistent routines for their children, and provide more cognitively stimulating environments often display greater academic and behavioral functioning, even after accounting for SES and other sociodemographic characteristics (Iruka, LaForett, & Odom, 2012). Other potentially important features of the home and family include whether a family member has a mental illness, learning disability, or special need; whether the mother has health problems, is depressed, or socially isolated; how much time the child spends watching television; and whether or not the child attends day care. Parental mental and physical health problems are associated with cognitive and other delays in young children (Breaux, Harvey, & Lugo-Candelas, 2013). Toddlers and preschool-aged children who frequently watch television are more likely to enter school with lower academic functioning, particularly in reading (Pagani, Fitzpatrick, & Barnett, 2013). This is possibly due to television viewing displacing storybook reading (Koolstra & Van der Voort, 1996) and limiting growth in children's cognitive and attentional capacities (Christakis, Zimmerman, DiGiuseppe, & McCarty, 2004). Conversely, educational or subtitled programs may instead help increase young children's achievement (Ennemoser & Schneider, 2007). Frequently attending child care may increase children's risk for behavior problems, including during the transition to kindergarten (NICHD Early Child Care Research Network, 2003).

Young children's own level of cognitive and behavioral functioning prior to or by kindergarten entry constitute additional potential confounds. Cognitive functioning strongly predicts children's later academic achievement and behavior (Duncan et al., 2007), and is likely related to children's oral vocabularies (e.g., Menting et al., 2010). Behavioral self-regulation (e.g., attentiveness, task persistence), externalizing behavior problems (e.g., aggressiveness), and internalizing behavior problems (e.g., anxiety, withdrawal) are also associated with children's oral vocabularies (Menting et al., 2010) and should autoregressively predict later behavioral functioning (Morgan, Farkas, & Wu, 2009).

Study's Purpose

We sought to identify sociodemographic, gestational and birth, cognitive and behavioral, and family functioning factors associated with or predictive of U.S. children's oral vocabularies at 24 months of age. We also evaluated whether and to what extent the children's oral vocabularies uniquely predicted their academic and behavioral functioning at kindergarten entry. Our study investigated three specific research questions. First, which U.S. children display larger or smaller oral vocabularies at 24 months of age? Second, does having a larger oral vocabulary at 24 months of age uniquely predict greater academic functioning at kindergarten entry? Third, does having a larger oral vocabulary at 24 months of age uniquely predict greater behavioral functioning at kindergarten entry?

Method

Design and Analytical Samples

We analyzed data from the Early Childhood Longitudinal Study–Birth Cohort (ECLS–B), a population-based, longitudinal cohort assessed from birth to kindergarten entry (http://nces.ed.gov/ecls/birth.asp). This sample was selected from birth certificate records and includes oversamples of particular population subgroups (e.g., Native Americans and Alaska Natives, children born with very low birth weight), with sample weights provided to generate nationally representative estimates. ECLS–B field staff individually administered measures of children's cognitive and academic functioning and conducted interviews with family members, when the children were 9, 24, 48, and 60 months of age. Kindergarten teachers rated the children's behaviors at school entry.

We identified three analytical samples. For the 0- to 24-month analyses, children with missing data on the study's 24-month oral vocabulary measure were excluded, as were children with congenital anomalies. We used multiple imputation (MI) procedures to account for missing data for predictor variables but not for the oral vocabulary variable in the remaining cases. Specifically, we used Imputation and Variance Estimation Software or IVEware (http://www.isr.umich.edu/src/smp/ive/) to repeatedly replace missing values with predictions based on random draws from the posterior distributions of observed sample parameters, which results in multiple complete data sets (Raghunathan, Solenberger, & Van Hoewyk, 2002). We averaged results obtained across five different imputation samples to account for random variations in the data sets derived from MI (Raghunathan et al., 2002). This resulted in an analytical sample of 8,650 with data for analyses evaluating factors predictive of 24-month-old children's oral vocabularies. For the 24- to 60-month analyses of reading and mathematics achievement, we again multiply imputed the predictor variables but excluded cases with missing data on 60-month reading or mathematics achievement measures ($N = 6{,}050$). For the 24- to 60-month analyses of behavioral functioning, we multiply imputed the predictor variables but excluded cases with missing data on the behavioral measures ($N = 4{,}350$). (All reported sample sizes are rounded to the nearest 50 to comply with National Center for Education Statistics [NCES], U.S. Department of Education requirements for data reporting.) Table 1 displays weighted percentages or means or standard deviations for the variables. The means of the variables are quite similar across the three samples, suggesting that the samples are comparable despite varying in size due to missing dependent variable data.

Measures, Criterion Variables

Oral Vocabulary, 24 Months

Oral vocabulary size at 24 months was assessed using a modified version of the MacArthur–Communicative Development Inventory (M–CDI; Fenson, Dale, Reznick, Thal, & Bates, 1993) developed specifically for the ECLS–B by the CDI Advisory Board. This measure is a parent survey of children's expressive use of 50 words commonly known and spoken in the targeted age range. An equivalent list of Spanish words was provided for Spanish-speaking parents; non-Spanish-speaking language minority parents were not included in the analyses. Internal consistency for the original M–CDI vocabulary scales is high ($\alpha = .96$). The M–CDI displays construct, concurrent, and predictive validity (Fenson et al., 1994) and classifies children into language status groups with 97% accuracy (Skarakis-Doyle, Campbell, & Dempsey, 2009). The number of words spoken by children as identified by parents was summed to create the Total Word score at 24 months. The mean of this variable was about 29 words, with a standard deviation of about 12. (Because this score was obtained using the shortened version of the M–CDI, it is not directly comparable to the 24-month mean number of words spoken measured by the original M–CDI.)

Reading and Mathematics Achievement, 60 Months

The ECLS–B Reading Test consisted of 55 items designed to assess language development, emergent literacy, and basic reading. The Mathematics Test included 42 items designed to assess number sense, counting, operations, geometry, patterns, and measurement. Each measure consisted of a two-stage routing procedure and item response theory (IRT)

Table 1
Weighted Percentages or Means with Standard Deviations of the Study's Three Analytical Samples

Variables	Sample 1[a]	Sample 2[b]	Sample 3[c]
Total Word score			
24 months	28.57 (11.83)	28.84 (11.79)	28.72 (12.00)
Reading Test score			
60 months	38.39 (14.83)	38.35 (14.75)	38.55 (14.86)
Mathematics Test score			
60 months	40.17 (10.56)	40.24 (10.53)	40.49 (10.38)
Approaches to Learning			
24 months	13.92 (3.56)	13.98 (3.53)	13.97 (3.59)
60 months	18.53 (2.49)	18.51 (2.50)	18.50 (2.50)
Internalizing Problems			
24 months	4.41 (1.83)	4.35 (1.80)	4.40 (1.83)
60 months	6.31 (2.19)	6.33 (2.20)	6.32 (2.20)
Externalizing Problems			
24 months	4.87 (1.75)	4.84 (1.73)	4.86 (1.76)
60 months	6.96 (3.07)	7.01 (3.10)	7.02 (3.12)
Race			
White	54.2%	53.9%	54.4%
Black	13.6%	14.0%	13.0%
Hispanic	24.8%	25.0%	25.5%
Asian	2.7%	2.6%	2.6%
Native American	0.5%	0.5%	0.5%
Other	4.2%	4.1%	4.0%
Age			
24 months	24.16 (0.70)	24.15 (0.69)	24.15 (0.68)
Gender			
Male	51.1%	50.6%	51.5%
SES quintiles			
Lowest	19.3%	19.1%	18.4%
Second lowest	19.6%	20.0%	20.2%
Middle	20.0%	20.6%	21.0%
Second highest	20.7%	20.9%	20.8%
Highest	20.3%	19.4%	19.6%
Nonsingleton	3.3%	3.2%	3.3%
Mother's age at child's birth			
Equal to or older than 35	14.0%	13.7%	13.5%
Younger or equal to 18	6.9%	7.3%	7.4%
Marital status			
Not married	31.4%	31.2%	31.4%
Primary language			
Non-English	18.6%	18.0%	18.1%
Birth weight			
Very low	1.2%	1.2%	1.2%
Moderately low	6.2%	6.2%	6.2%
Labor complications	35.5%	34.8%	35.0%
Obstetric procedures	58.5%	57.5%	56.7%
Risks			
Medical	18.1%	17.7%	17.9%
Behavioral	11.1%	10.8%	10.7%
Parenting score			
24 months	7.32 (1.15)	7.33 (1.14)	7.34 (1.14)
Family member status			
Mental illness	10.7%	11.1%	10.7%
Learning disability	15.3%	15.4%	15.7%
Maternal status			
Health problems	7.3%	7.2%	7.0%
Household status			
Special need	7.4%	7.9%	7.8%
Mother depressed	13.7%	13.9%	14.7%
Stayed in day care center			
> 10 hr per week	14.0%	13.5%	13.8%
Child television usage			
Middle third	34.4%	33.9%	34.5%
Highest third	32.6%	33.0%	32.5%
Mother isolated	0.16 (0.44)	0.15 (0.44)	0.15 (0.45)
Bayley Mental score			
24 months	126.60 (10.49)	126.86 (10.33)	127.11 (10.67)

Note. Sample size rounded to nearest 50 per ECLS–B confidentiality requirements. Sample 1: N = 8,650; Sample 2: N = 6,050; Sample 3: N = 4,350. ECLS–B = Early Childhood Longitudinal Study-Birth Cohort; SES = socioeconomic status.
[a]Sample of ECLS–B children aged 0–24 months of age with complete data on Total Word score measure at 24 months of age. [b]Sample of ECLS–B children aged 24–60 months of age with complete data on the reading and mathematics achievement measures administered at 60 months of age. [c]Sample of ECLS–B children aged 24–60 months of age with complete data on the approaches to learning, externalizing problem behaviors, and internalizing problem behaviors measures administered at 60 months of age.

scaling. All children were initially given the same 24-question test. Then, and depending on the number of correct responses on this test, they were administered one of three follow-up routing test forms on the basis of scoring in the low, middle, or high range of the initial test. The Reading and the Mathematics Tests display IRT theta reliability coefficients of .92, indicating high reliability of the assessment scores (Najarian, Snow, Lennon, & Kinsey, 2010).

Behavioral Self-Regulation, Externalizing Problem Behaviors, and Internalizing Problem Behaviors, 60 Months

Teachers rated children's behavioral functioning using items from the Preschool Learning and Behavior Scales (2nd ed.), the Social Skills Rating

System, and the Early Childhood Longitudinal Study, Kindergarten Class of 1998–1999. Teachers rated the children's frequency of behaviors using a scale ranging from 1 (*never*) to 5 (*very often*). We conducted an exploratory factor analysis, using a promax rotation, of 22-rated behaviors, retaining a four-factor solution after examining several potential factor solutions and considering a priori criteria. Items with factor loadings lower than .60 were removed. We identified three of the four factors as relevant to this study: (a) approaches to learning, (b) internalizing problem behaviors, and (c) externalizing problem behaviors. The Approaches to Learning scale ($\alpha = .91$) contains five items measuring behavioral self-regulation (e.g., "pays attention well," "keeps working until finished," and [reverse scaled] "has difficulty concentrating"). The Internalizing Problem Behaviors scale ($\alpha = .64$) contains three items related to anxious or withdrawn behaviors (i.e. "seems unhappy," "worries about things," and "acts shy"). The Externalizing Problem Behavior scale ($\alpha = .87$) contains four items related to acting-out behaviors (e.g., "disrupts others," "has temper tantrums," "is physically aggressive"). Items were summed to obtain scale scores. Higher Approaches to Learning scale scores indicated more appropriate classroom-based behavioral self-regulation; higher Internalizing or Externalizing Problem Behaviors scale scores indicated more frequent problem behaviors.

Measures, Predictor Variables

Sociodemographic Characteristics

Sociodemographic data were collected in parent interviews at each assessment, as well as from birth certificates. Race or ethnicity was defined as the race or ethnicity of the mother from birth certificates. Non-Hispanic White was the reference group; other groups included non-Hispanic Black, Hispanic, Asian, Native American, and Other. Child age in months was included to account for variations in actual age at the time of assessment. Female was the reference gender category. ECLS–B staff calculated family SES using a composite of five parent-reported indicators that included the father/male guardian's education and occupation, the mother/female guardian's education and occupation, and household income. NCES estimated missing values, which averaged 2.5% across the five SES indicators, using hot deck imputation. The SES distribution was divided into quintiles and is represented in regressions as a set of dummy variables. The first quintile represented the lowest SES. Children born individually were considered singletons; all others were coded as nonsingletons. Dummy variables for whether the mother was equal to or over 35 years of age or less than or equal to 18 years of age at the time of the child's birth were also included. Being married was used as the reference category for marital status. Children living in households where English was not the primary language spoken were identified using a dichotomous variable.

Characteristics From Birth Certificates

A count of medical conditions in pregnancy included incompetent cervix, acute or chronic lung disease, chronic hypertension, pregnancy-induced hypertension, eclampsia, diabetes, hemoglobinopathy, cardiac disease, anemia, renal disease, genital herpes, oligohydramnios, uterine bleeding, Rh sensitization, previous birth weighing 4,000+ g, or previous preterm birth. Behavioral risk factors during pregnancy included any maternal use of alcohol and/or tobacco during pregnancy (coded as 1 if present and summed to form a scale that ranged from 0 to 2). Obstetrical procedures were measured as a count of total procedures including induction of labor, stimulation of labor, tocolysis, amniocentesis, and Cesarean section. Labor complications were measured as a count of the following: placental abruption anesthetic complications, dysfunctional labor, breech/malpresentation, cephalopelvic disproportion, cord prolapse, fetal distress, excessive bleeding, fever of > 100°F, moderate/heavy meconium, precipitous labor (< 3 hr), prolonged labor (> 24 hr), placental previa or seizures during labor. Two indicator variables were used to quantify very low (<1,500 g) and moderately low (1,500–2,500 g) birth weight. Normal (>2,500 g) birth weight was the reference category.

Parenting Quality, 24 Months

We averaged scores on two assessments conducted at 24 months to create a composite parenting score. The first assessment included items from the Home Observation for Measurement of the Environment (HOME; Bradley & Caldwell, 1984), a widely used measure of the quality of the child's parenting and the home environment (e.g., NICHD Early Childcare Research Network, 2005). NCES retained a subset of the original measure's 21 items measuring (a) parental activities including reading to the child, telling stories, singing, and taking the child on errands or to public places; (b) having toys, records, books, and audiotapes available in the home; and (c) having a safe and supportive home environment. Because the modified HOME scale had relatively low internal consistency (α = .46), the ECLS–B manual advises researchers to use alternatives other than scaling the items. We therefore used a count of 14 HOME scores items to indicate the extent to which these positive activities were reported or observed.

The second parenting assessment consisted of ratings of the quality of a parent's interactive support of their child, as coded from videotaped interactions during the Two Bags Task, a simplified version of the Three Bags Task used in the Early Head Start Research and Evaluation Project and the NICHD Study of Early Child Care (Nord, Edwards, Andreassen, Green, & Wallner-Allen, 2006). Interviewers read a script to the children's parents, after which, over the next 10 min, parents were asked to play with their children using a wordless picture book (i.e., *Goodnight Gorilla*) and a set of toy dishes. A composite variable measuring parental support was created for the ECLS–B representing the mean of three characteristics of parental interactions with their children: (a) sensitivity, (b) stimulation of cognitive development, and (c) positive regard. Each item was scored on a 7-point scale, ranging from 1 = *very low* to 7 = *very high*. Mean interrater reliability for the parent rating scales was 97%, with mean reliabilities of 97%, 93%, and 94% for sensitivity, cognitive stimulation, and positive regard, respectively (see Andreassen, Fletcher, & Park, 2007, for additional measurement detail).

History of Mental or Physical Illness or Disabling Conditions, 9 Months

Family member with mental illness. Mothers were asked at the 9-month survey whether they or a family member had "a serious mental illness, such as schizophrenia, a paranoid disorder, a bipolar disorder, or manic episodes?" "Yes" answers were coded as 1; "no" answers were coded as 0.

Family member with learning disability. Mothers were also asked at 9 months, "Have you or any of your blood relatives ever had a learning disability?" "Yes" answers were coded as 1; "no" answers were coded as 0.

Maternal health problems. During the 9-month wave, mothers rated their overall health on a scale of 1–5. The responses were transformed into a dichotomous variable, with responses of 4 (*fair*) or 5 (*poor*) coded as 1. All other responses (e.g., "excellent") were coded as 0.

Special needs. Mothers responded during the 9-month survey whether they or any other household members had a special need, delay or disability. "Yes" responses were coded as 1; "no" responses were coded as 0.

Maternal depression. A modified version of the Center for Epidemiologic Studies–Depression (CES–D) scale (Radloff, 1977) was used as part of the 9-month parent self-administered questionnaire. The modified CES–D scale includes 12 items including having poor appetite, feeling lonely, and trouble keeping focus. Scores were dichotomized so that a total score greater than 9 was coded as 1 for presence of depressive symptoms, corresponding to the cutoff commonly used for the full CES–D of greater than 15 (Nord et al., 2006).

Maternal social isolation. Five variables were used to construct a scale of maternal social isolation. Four of these variables asked the mother if she had people available to ask for help for various needs (1 = "no one" for each variable). The other variable asked about being close to her own mother (1 = "not close"). The sum of these five variables was calculated and used as a measure of social isolation.

Hours per Week in Child-Care Center, 24 Months

During the 24-month survey, parents were asked how many hours a week their child spends in a child-care center. Responses to this question were coded dichotomously so that a response of 11 hr or more was coded as 1.

Television Usage, 24 Months

Average weekly television usage was calculated based on a parent's response at 24 months about the child's average number of hours spent watching television or videos in the household during weekdays and nends. Less than 9 hr was considered low television usage, between 9 and 17 hr was considered medium television usage, and more than 17 hr was considered high television usage.

Cognitive Functioning, 24 Months

A standardized assessment was administered at the 24-month survey wave to measure children's general cognitive functioning. Field staff individually administered the Bayley Short Form–Research Edition (BSF–R), a modified version of the Bayley

Scales of Infant Development, 2nd ed. (BSID–II; Bayley, 1993), which is designed for use with children from birth to 36 months of age. In both the BSID–II and the BSF–R, the mental score is based on the trained interviewer's assessment of a child's ability to perform tasks related to memory, habituation, preverbal communication, problem solving, and concept attainment. The IRT reliability coefficient of the BSF–R mental scale at 24 months was .88 (Andreassen et al., 2007). The reported R^2 between BSF–R and BSID–II scores was .99, indicating that the BSF–R maintains the psychometric properties of the BSID–II and accurately measures children's performance across the ability distribution (Andreassen et al., 2007).

Behavioral Self-Regulation, Externalizing Problem Behaviors, and Internalizing Problem Behaviors, 24 Months

Early Childhood Longitudinal Study–Birth Cohort trained examiners used the Behavior Rating Scale–Research Edition (BRS–R) to rate children's behaviors as they completed BSF–R tasks during the 24-month survey wave. The BRS–R was adapted from the Behavior Rating Scale (BRS; Bayley, 1993). Scores on the BRS correlate moderately to highly with scores on other measures of young children's socioemotional adjustment (Buck, 1997). The BRS–R included 11 interviewer-rated items from the full BRS measuring developmentally appropriate behaviors for 24-month-old children including their attention to task, persistence, cooperation with an examiner, interest in the testing materials, and frustration with testing tasks (Nord et al., 2006). A 5-point scale was used to rate the frequency of the observed behavior. A higher score indicated that the problem behavior occurred infrequently. The self-regulatory items on the BRS (e.g., attention to task, persistence) had an internal consistency of .92.

We used eight items from the BRS–R to control for prior behavioral functioning. Four items measured children's prior behavioral self-regulation (e.g., "pays attention to tasks," "is persistent in tasks"). Two items measured prior externalizing behaviors (i.e., "frustration in tasks," "cooperation"). Two items measured prior internalizing problem behaviors (i.e., "fearlessness," "social engagement"). Specific items were reverse coded as appropriate to be consistent with either appropriate (i.e., for behavioral self-regulation) or problematic (i.e., for externalizing or internalizing) behavioral functioning. Cronbach's alphas were .90, .64, and .72 for the 24-month behavioral self-regulation, externalizing problem behaviors, and internalizing problem behaviors measures, respectively.

Analytical Methods

The score distribution of the measure of 24-month-old children's parent-reported oral vocabulary generally resembled a normal curve, with a truncation point at 50 words (i.e., the maximum possible score). There are 280 cases of about 9,500 (i.e., 2.9%) at this truncation point. To avoid bias due to truncation at the upper limit of the variable (ceiling effect), we used Tobit regression analysis when predicting children's scores on the oral vocabulary measure. Our first set of analyses estimated six Tobit regression models predicting 24-month-old children's oral vocabularies. We entered these sets of predictors sequentially. As shown in Table 2, Model 1 estimated to what extent children's or families' sociodemographic characteristics functioned as predictors. The sociodemographic variables included children's race or ethnicity, age, gender, and SES. Model 2 added additional sociodemographic variables to the regression equation. Model 3 added the children's gestational and birth characteristics. Model 4 entered predictors related to family risk and resilience. Model 5 added children's behavioral functioning; Model 6 added their cognitive functioning. Estimating these models sequentially allowed us to investigate whether there were significant direct effects of these groupings of variables on 24-month-old children's oral vocabularies, as well as whether these groupings of variables explained the direct effects of the previously entered variables.

Our second and third sets of analyses investigated whether and to what extent, and before and after extensive statistical control, having a larger oral vocabulary at 24 months of age predicted children's academic and behavioral functioning at 60 months of age. We conducted separate ordinary least squares regression analyses predicting each of the five criterion variables. Predictor variables in these regression analyses included oral vocabulary, sociodemographic and birth characteristics, family risk and resilience characteristics, and children's cognitive and behavioral functioning at 24 months of age. We used SAS 9.3 (SAS Institute Inc., Cary, NC) to perform the analyses. We incorporated sampling weights and design effects to account for oversampling of some population subgroups and for the stratified cluster design of the ECLS–B. We used an alpha of $p < .05$ in establishing statistical significance including for our primary analyses

Table 2
Parameter Estimates (Standardized) of Tobit Regression Equations Predicting Children's Oral Vocabularies at 24 Months, ECLS–B Data

Variables	Model 1[a]	Model 2[b]	Model 3[c]	Model 4[d]	Model 5[e]	Model 6[f]
Intercept	0.92***	0.98***	0.96***	0.75***	0.69***	0.26***
Race						
Black	−0.02	0.01	0.03	0.17***	0.16***	0.25***
Hispanic	−0.17***	−0.12**	−0.12**	−0.06	−0.06	0.05
Asian	−0.13	−0.05	−0.05	0.12	0.13	0.11
Native American	−0.15	−0.16	−0.16	−0.07	−0.04	0.16
Other	−0.06	−0.08	−0.06	−0.0001	0.02	0.08
Age						
24 months	0.19***	0.18***	0.18***	0.18***	0.17***	0.08***
Gender						
Male	−0.52***	−0.51***	−0.52***	−0.49***	−0.44***	−0.26***
SES quintile						
Lowest	−0.55***	−0.57***	−0.54***	−0.22***	−0.21***	−0.08*
Second lowest	−0.44***	−0.47***	−0.45***	−0.20***	−0.22***	−0.06
Middle	−0.32***	−0.34***	−0.33***	−0.17***	−0.18***	−0.04
Second highest	−0.21***	−0.22***	−0.22***	−0.13**	−0.12**	−0.02
Nonsingleton		−0.47***	−0.30***	−0.28***	−0.24***	−0.13*
Mother's age at child's birth						
Equal to or older than 35		−0.13***	−0.13**	−0.14***	−0.14***	−0.11***
Younger or equal to 18		−0.05	−0.04	−0.03	−0.01	−0.05
Marital status						
Not married		0.02	0.03	0.06	0.08*	0.08**
Primary language						
Non-English		−0.12*	−0.12**	−0.05	−0.05	0.10*
Birth weight						
Very low			−0.88***	−0.87***	−0.83***	−0.39***
Moderately low			−0.24***	−0.23***	−0.21***	−0.05
Labor complications			0.01	0.002	0.01	0.001
Obstetric procedures			0.05**	0.05*	0.05*	0.04**
Risks						
Medical			−0.04	−0.03	0.01	−0.03
Behavioral			−0.06	−0.04	−0.01	0.01
Parenting score at 24 months				0.28***	0.24***	0.10***
Family member status						
Mental illness				−0.12**	−0.12**	−0.09
Learning disability				−0.03	−0.02	0.03
Maternal status						
Health problems				−0.27***	−0.24***	−0.15***
Household status						
Special need				−0.16***	−0.14**	−0.05
Mother depressed				0.02	0.03	0.02
Stayed in day-care center						
> 10 hr per week				0.12**	0.12**	0.03
Child television usage						
Middle third				0.01	0.10	−0.01
Highest third				−0.11***	−0.09**	−0.04
Mother isolated				−0.03*	−0.03*	−0.02
Approaches to learning						
24 months					0.62***	0.20***
Internalizing problems						
24 months					−0.27***	−0.08**

Table 2
Continued

Variables	Model 1[a]	Model 2[b]	Model 3[c]	Model 4[d]	Model 5[e]	Model 6[f]
Externalizing problems						
24 months					−0.30***	−0.07
General cognitive functioning						
24 months						0.61***

Note. N = 8,650. Sample size rounded to nearest 50 per ECLS–B confidentiality requirements. ECLS–B = Early Childhood Longitudinal Study–Birth Cohort; SES = socioeconomic status.
[a]Model 1 = Intercept, race, age, gender, and SES. [b]Model 2 = Adds maternal age, marital status, and primary language spoken in the home as additional predictors. [c]Model 3 = Adds birth weight, labor complications, obstetric procedures, medical and behavioral risks as predictors. [d]Adds parenting, family and maternal and household status, maternal depression, child care, television usage, and maternal isolation as predictors. [e]Adds behavioral self-regulation and problem behaviors as predictors. [f]Adds general cognitive functioning as a predictor.
*$p < .05$. **$p < .01$. ***$p < .001$.

(Moyé, 2008; see Appendix S3 for multiplicity check information).

Results

Which U.S. Children Display Larger or Smaller Oral Vocabularies at 24 Months of Age?

Table 2 displays results from Tobit regressions predicting children's oral vocabularies at 24 months of age. All continuous variables (including the dependent variable) were standardized. Thus, all coefficients represent directly comparable standardized coefficients (i.e., effect sizes).

The first column (Model 1) shows the very strong and significant effects of gender and SES. Boys averaged .52 *SD* fewer words spoken than girls. This gap is similar in magnitude to the vocabulary gap by U.S. children in the lowest and highest SES quintiles. (Thus, a boy toddler from the lowest SES quintile, on average, experienced a double decrement summing to somewhat more than 1 *SD*.) The association between SES quintiles and words spoken was approximately linear, with a difference of about .10 *SD* for each successive quintile. In contrast, there was only an inconsistent association between children's race or ethnicity and oral vocabularies.

The second column shows that, among additional sociodemographics, the largest association with 24-month-old children's oral vocabularies involved the .47 *SD* decrement experienced by nonsingletons. Although this association was reduced in size in subsequent models, it remained significant. A modest (.13 *SD*) but significant decrement was observed for the children of older mothers. A decrement of .12 was observed for children from homes where English was not the primary spoken language. Controlling for this language variable also partially explained the negative relation between children's Hispanic status and their oral vocabulary size.

The third column adds gestational and birth characteristics as predictors. There was a very strong negative predictive relation (−.88 *SD*) between very low birth weight and 24-month-old children's oral vocabularies. The relation with moderately low birth weight was smaller (−.24 *SD*) but also statistically significant. The effects of labor complications, obstetric procedures, and the mother's medical and behavioral risks during pregnancy were small. Including these covariates in the regression equation reduced the predicted effect of being a nonsingleton by about one third. Thus, a portion of this relation appeared to be due to the relatively lower birth weights of nonsingletons. The fourth column displays the results of adding family risk and resilience factors to the regression equation. Two resilience factors—parenting quality and day-care attendance—were both significantly associated with 24-month-old children having larger oral vocabularies, with predicted effect sizes of .28 and .12 *SD*, respectively. Among the risk factors, several were also significantly and negatively associated with oral vocabulary. These included a family member with a mental illness (−.12 *SD*), maternal health problems (−.27 *SD*), a household member with special needs (−.16 *SD*), and the child being in the highest third of television usage (−.11 *SD*). These factors helped explain the predicted effect of SES. Following their statistical control, the association between each SES quintile and children's oral vocabularies decreased by about 50% but remained significant.

The fifth and sixth columns of Table 2 show the results of adding the 24-month behavioral and general cognitive functioning measures into the regression equation. The three behavioral measures were associated in expected directions with oral vocabulary, so that 24-month-old children who displayed more attentive, task persistent, and other types of learning-related behaviors also displayed larger oral vocabularies (.62 *SD*), while those children with stronger internalizing or externalizing problem behaviors displayed smaller oral vocabularies (−.27 and −.30 *SD*, respectively).

Because the measures of general cognitive functioning and oral vocabulary were both language dependent, we expected to find a strong association between the two variables. As shown in Model 6, the relation was indeed very strong and significant (.61 *SD*). However, even with these behavioral and general cognitive functioning controls added to the regression equation, most of the associations remained statistically significant despite decreasing in magnitude. The exception was family SES, suggesting that the relation between SES and 24-month-old children's oral vocabularies was partially accounted for by other risk factors. These included being a raised by a single mother, being born with low birth weight, experiencing less warm or cognitively stimulating parenting, being raised in a household with a socially isolated mother or one who has health problems, and, mostly strongly, by children's own level of general cognitive and behavioral functioning. However, being in the lowest SES quintile remained significantly negatively related to children's oral vocabulary size despite extensive statistical control. Oral vocabulary at 24 months functioned somewhat independently of general cognitive functioning, which is a conclusion that is also supported by results in the study's second set of analyses.

Does Having a Larger Oral Vocabulary at 24 Months of Age Uniquely Predict Greater Academic Functioning at Kindergarten Entry?

Table 3 displays the results of using 24-month-old children's oral vocabulary, as well as the full set of additional risk and resilience factors just presented, to predict their academic functioning at kindergarten entry. The first model of Table 3 displays the unadjusted estimate between oral vocabulary and reading or mathematics achievement. Then the second model adds control variables to the regression equation. The third column adds general cognitive functioning as a control, allowing for a highly conservative test of the hypothesized relation. Oral vocabulary size initially predicted 24-month-old children's reading and mathematics achievement at kindergarten entry. These predicted effect sizes were .22 and .27 *SD*, respectively.

Model 2 shows that despite statistical control for a wide range of covariates, having a larger oral vocabulary at 24 months of age remained positively and significantly predictive of greater academic functioning at kindergarten entry. Model 3's results indicate that even after controlling for 24-month-old children's general cognitive functioning, having a larger oral vocabulary positively and significantly predicted their later reading and mathematics achievement. The adjusted effect sizes were .07 and .10 *SD* for reading and mathematics achievement, respectively.

Table 3 identifies additional factors consistently predictive of greater academic functioning. These included being White or Asian, being from a high-SES family, being born as a singleton, watching television more frequently, and displaying higher levels of general cognitive functioning. However, 24-month-old children's oral vocabularies remained uniquely predictive of their academic functioning at kindergarten entry despite the large number of controls. We also investigated (results not shown) the possibility that SES moderated the predicted effect of oral vocabulary on academic functioning (as well as behavioral functioning). We did so by adding interaction terms between the four SES dummy variables and oral vocabulary to the regression equations. These interaction terms were not statistically significant.

Does Having a Larger Oral Vocabulary at 24 Months of Age Uniquely Predict Greater Behavioral Functioning at Kindergarten Entry?

Table 4 displays regressions predicting teacher ratings of kindergarten children's behavioral self-regulation, as well as their internalizing and externalizing problem behaviors. Having a larger oral vocabulary significantly predicted all three indicators of behavioral functioning in Model 1. Specifically, 24-month-old children with larger oral vocabularies displayed greater behavioral self-regulation (.22 *SD*) and fewer internalizing and externalizing problem behaviors at kindergarten entry (−.11 and −.14 *SD*, respectively). Adding Model 2 and 3's controls to the regression equation reduced oral vocabulary's predictive relations with the three indicators of children's behavioral functioning but the relations remained statistically significant. Having a larger oral vocabulary predicted greater

Table 3
Parameter Estimates (Standardized) of OLS Regressions Predicting Children's Academic Achievement at 60 Months, ECLS–B Data

	Reading achievement			Mathematics achievement		
Variables	Model 1[a]	Model 2[b]	Model 3[c]	Model 1[a]	Model 2[b]	Model 3[c]
Intercept	−0.07**	0.37***	0.33***	−0.05*	0.38***	0.31***
Oral vocabulary						
24 months	0.22***	0.12***	0.07***	0.27***	0.17***	0.10***
Race						
Black		−0.02	0.003		−0.20***	−0.17**
Hispanic		−0.04	−0.02		−0.14*	−0.11
Asian		0.46***	0.47***		0.30***	0.31***
Native American		−0.19*	−0.15		−0.36***	−0.30**
Other		−0.08	−0.06		−0.14	−0.12
Child age						
24 months		0.14***	0.13***		0.12***	0.11***
Gender						
Male		−0.10**	−0.08*		0.01	0.03
SES quintile						
Lowest		−0.78***	−0.76***		−0.77***	−0.75***
Second lowest		−0.59***	−0.57***		−0.59***	−0.57***
Middle		−0.39***	−0.37***		−0.40***	−0.38***
Second highest		−0.24***	−0.23***		−0.23***	−0.22***
Nonsingleton		−0.08*	−0.08*		−0.10*	−0.09*
Mother's age at child's birth						
Equal to or older than 35		−0.01	−0.02		0.03	0.02
Younger or equal to 18		−0.10	−0.11		−0.11*	−0.12*
Marital status						
Not married		−0.07	−0.07		−0.04	−0.04
Primary language						
Non-English		−0.03	−0.004		−0.002	0.03
Birth weight						
Very low		−0.10*	−0.05		−0.28***	−0.21***
Moderately low		−0.03	−0.01		−0.07	−0.04
Labor complications		−0.06	−0.06		−0.003	−0.003
Obstetric procedures		0.02	0.02		0.01	0.02
Risks						
Medical		−0.07*	−0.07*		−0.004	−0.01
Behavioral		−0.06	−0.05		−0.06	−0.04
Parenting score						
24 months		0.03	0.02		0.05*	0.02
Family member status						
Mental illness		0.04	0.05		0.01	0.01
Learning disability		−0.07	−0.07		−0.10*	−0.09*
Maternal status						
Health problems		−0.03	−0.02		−0.08	−0.07
Household status						
Special need		0.02	0.02		−0.02	−0.01
Mother depressed		−0.02	−0.03		−0.04	−0.05
Stayed in day-care center						
> 10 hr per week		0.04	0.03		0.05	0.04
Child television usage						
Middle third		0.10*	0.09*		0.11**	0.10**
Highest third		0.10*	0.11**		0.11**	0.12**
Mother isolated		−0.02	−0.02		−0.05***	−0.05**
Approaches to learning						
24 months		0.18**	0.12*		0.14**	0.06

Table 3
Continued

	Reading achievement			Mathematics achievement		
Variables	Model 1[a]	Model 2[b]	Model 3[c]	Model 1[a]	Model 2[b]	Model 3[c]
Internalizing problems						
24 months		0.04	0.07		0.02	0.05
Externalizing problems						
24 months		−0.05	−0.02		−0.06	−0.02
General cognitive functioning						
24 months			0.12***			0.16***

Note. N = 6,050. Sample size rounded to nearest 50 per ECLS–B confidentiality requirements. OLS = ordinary least squares; ECLS–B = Early Childhood Longitudinal Study–Birth Cohort; SES = socioeconomic status.
[a]Intercept and oral vocabulary as predictors. [b]Adds race, age, gender, SES, nonsingleton, maternal age, language spoken in the home, birth weight, labor complications, obstetric procedures, medical and behavioral risks, parenting, family and maternal and household status, maternal depression, child care, television usage, maternal isolation, behavioral self-regulation and problem behaviors as predictors. [c]Adds general cognitive functioning as a predictor.
*p < .05. **p < .01. ***p < .001.

behavioral self-regulation (.10 *SD*), as well as fewer internalizing (−.09 *SD*) and externalizing problem behaviors (−.06 *SD*) even following statistical control for autoregressive behavioral functioning. Other less consistent predictors of children's behavioral functioning included being a boy, being raised by a single mother, and frequently attending child care.

Discussion

Our analyses of a population-based data set identify which groups of 24-month-old children in the United States are at risk of having smaller oral vocabularies. Our results are consistent with prior research indicating that children being raised in low-SES families are likely to have smaller oral vocabularies (e.g., Fernald et al., 2013; Hart & Risley, 1995). This specific relation is partially explained by a more general set of sociodemographic, gestational and birth, family risk and resilience, and individual characteristics, particularly children's own levels of cognitive functioning. Other studies report that family stress and investment characteristics mediate the relation between lower SES and academic achievement, but the extent to which this occurs for oral vocabulary has been unclear (Farkas & Beron, 2004), in part due to a range of measures, sampling, and analytical methods being used when examining SES (Hoff, Laursen, & Bridges, 2012). Our results indicate that family stress and investment characteristics partially explain the relation between family SES and children's oral vocabulary size.

The results further indicate that 24-month-old children with smaller oral vocabularies are at risk of entering kindergarten with lower academic and behavioral functioning. Consistent with previously theorized mechanisms, oral vocabulary has both a general and unique relation with children's development. The relation is evident across multiple indicators of both academic and behavioral functioning during early childhood. Twenty-four-month children's oral vocabularies remain predictive of their academic and behavioral functioning at kindergarten entry despite extensive statistical control for many factors previously identified as potential confounds.

Limitations

This study has at least five limitations. First, our measure of children's oral vocabulary size is brief and relies on parental recall. We also used children's scores on this measure to predict their performance on independently administered measures of academic and behavioral functioning 3 years later. The resulting measurement error, as well as multiyear time interval, should bias our estimates downward, possibly making them overly conservative. This type of limitation extends to the measure of general cognitive functioning. Because the general cognitive functioning measure was also administered orally and at times required verbal responses, this confound should be highly correlated with 24-month-old children's oral vocabularies. Consequently, use of a brief survey of parental report of 50 words spoken by their 24-month-old children, as well as statistical control for correlated verbal intelligence, may have resulted in very conservative estimates of oral vocabulary's "true" rela-

Table 4
Parameter Estimates (Standardized) of OLS Regressions Predicting Children's Behavioral Functioning at 60 months, ECLS–B Data

	Approaches to learning			Internalizing problems			Externalizing problems		
Variables	Model 1[a]	Model 2[b]	Model 3[c]	Model 1[a]	Model 2[b]	Model 3[c]	Model 1[a]	Model 2[b]	Model 3[c]
Intercept	0.02	0.34***	0.30***	−0.03	−0.17*	−0.15	0.03	−0.42***	−0.40***
Oral vocabulary									
24 months	0.22***	0.15***	0.10***	−0.11***	−0.10***	−0.09**	−0.14***	−0.07***	−0.06*
Race									
Black		0.05	0.08		−0.15*	−0.16*		0.04	0.03
Hispanic		0.04	0.06		−0.04	−0.05		−0.13*	−0.14*
Asian		−0.06	−0.05		0.03	0.02		−0.16*	−0.16*
Native American		−0.02	0.03		0.06	0.04		0.32	0.31
Other race		−0.002	0.02		0.03	0.03		−0.03	−0.03
Child age									
24 month		−0.03	−0.03		0.05*	0.06*		0.003	0.01
Gender									
Male		−0.22***	−0.21***		0.02	0.02		0.42***	0.42***
SES quintile									
Lowest		−0.16	−0.15		0.19*	0.19*		0.11	0.11
Second lowest		−0.20*	−0.18*		0.22**	0.22**		0.14	0.14
Middle		−0.12*	−0.11		0.26***	0.25***		0.06	0.05
Second highest		−0.05	−0.04		0.10	0.10		0.04	0.03
Nonsingleton		0.05	0.06		−0.04	−0.04		−0.05	−0.05
Mother's age at child's birth									
Equal to or older than 35		−0.02	−0.03		0.01	0.01		−0.01	−0.001
Younger than or equal to 18		−0.08	−0.09		−0.03	−0.03		0.04	0.04
Marital status									
Not married		−0.21**	−0.21**		−0.05	−0.05		0.23***	0.23**
Primary language									
Non-English		0.02	0.04		−0.14	−0.15		−0.11	−0.12
Birth weight									
Very low		−0.24***	−0.19**		−0.01	−0.03		−0.06	−0.07
Moderately low		−0.06	−0.04		0.001	−0.005		−0.03	−0.04
Labor complications		−0.01	−0.01		0.11**	0.11**		0.02	0.02
Obstetric procedures		−0.04	−0.04		0.001	−0.0001		−0.02	−0.02
Risks									
Medical		−0.08	−0.08		0.03	0.03		0.13*	0.12*
Behavioral		−0.13	−0.12		−0.06	−0.07		0.18	0.17
Parenting score									
24 months		0.08**	0.06*		−0.01	−0.005		−0.04	−0.03
Family member status									
Mental illness		−0.15	−0.14		0.04	0.04		0.13	0.13
Learning disability		−0.02	−0.01		0.11	0.11		0.11	0.11
Maternal health problems		−0.13	−0.13		0.22*	0.22*		−0.03	−0.03
Household status									
Special need		−0.06	−0.05		0.02	0.02		0.06	0.06
Mother depressed		−0.11	−0.11		0.02	0.02		0.15*	0.15*
Stayed in day-care center									
> 10 hr per week		−0.14*	−0.15*		−0.06	−0.06		0.30***	0.31***
Child television usage									
Middle third		0.10*	0.10*		−0.03	−0.03		−0.004	−0.003
Highest third		0.09	0.10*		−0.10	−0.11		−0.05	−0.05
Mother isolated		−0.04*	−0.04*		0.01	0.01		0.04	0.04
Approaches to learning									
24 months		0.12*	0.06						

Table 4
Continued

	Approaches to learning			Internalizing problems			Externalizing problems		
Variables	Model 1[a]	Model 2[b]	Model 3[c]	Model 1[a]	Model 2[b]	Model 3[c]	Model 1[a]	Model 2[b]	Model 3[c]
Internalizing problems									
24 months					0.15*	0.14			
Externalizing problems									
24 months								0.27**	0.25**
General cognitive functioning									
24 months			0.11**			−0.03			−0.04

Note. N = 4,350. Sample size rounded to nearest 50 per ECLS–B confidentiality requirements. OLS = ordinary least squares; ECLS–B = Early Childhood Longitudinal Study–Birth Cohort; SES = socioeconomic status.
[a]Intercept and oral vocabulary as predictors. [b]Adds race, age, gender, SES, nonsingleton, maternal age, language spoken in the home, birth weight, labor complications, obstetric procedures, medical and behavioral risks, parenting, family and maternal and household status, maternal depression, child care, television usage, maternal isolation, behavioral self-regulation and problem behaviors as predictors. [c]Adds general cognitive functioning as a predictor.
$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

tion with later academic and behavioral functioning. Second, and again due to the ECLS–B's design and measurement limitations, we were unable to directly contrast oral vocabulary's predictive utility against a variety of other early language or numeracy competencies (e.g., phonological awareness, number sense, working memory) that may also be predictive of later academic and behavioral functioning (e.g., Fitzpatrick & Pagani, 2012). However, many of these competencies should be correlated with other controls included in our study (e.g., SES, prior behavioral and general cognitive functioning). Third, a measure of expressive but not receptive vocabulary was available in the ECLS–B's 24-month survey wave. Therefore, we were unable to directly contrast the relative contribution of expressive versus receptive vocabulary knowledge to children's academic or behavioral functioning at school entry. However, strong positive correlations have been found between receptive and expressive vocabulary (e.g., r = .66; Sideridis & Simos, 2010), and Tomblin and Zhang's (2006) large-scale investigation of young children's language abilities yielded no evidence for a receptive–expressive vocabulary dissociation. Measuring children's ability to speak words should also better index the relative size of their vocabularies than measuring their ability to comprehend spoken words (Sénéchal et al., 2006). Fourth, although other studies indicate that academic and behavioral functioning by school entry contribute to long-term educational and societal opportunities (e.g., Chetty et al., 2011), we were unable to directly evaluate whether oral vocabulary continued to contribute to children's academic and behavioral functioning as they progressed through elementary school. This is because the ECLS–B's data collection ended at kindergarten entry. Fifth, the ECLS–B's data collection did not allow us to report on the quality and quantity of children's overall language exposure in the home. Language input in the home may also explain the relation between family SES and children's oral vocabulary (Fernald et al., 2013; Hart & Risley, 1995).

Study's Contributions and Implications

Oral vocabulary is theorized to contribute to many indicators of children's academic and behavioral functioning, including reading and mathematics achievement, behavioral self-regulation, and frequency of externalizing and internalizing problem behaviors (e.g., LeFevre et al., 2010; Perfetti & Stafura, 2014; Qi & Kaiser, 2004). Meaningful differences in children's oral vocabularies have been reported to occur by 24 months of age (e.g., Fernald et al., 2013). These differences have been hypothesized to strongly contribute to later achievement gaps (Hart & Risley, 1995; Hoff, 2013). Yet methodological and substantive limitations in existing work have been identified (NELP, 2008), and oral vocabulary has sometimes been reported to fail to uniquely predict children's achievement (Schatschneider et al., 2004). The result is substantial ambiguity as to oral vocabulary's theoretical and practical importance as a contributor to children's academic and behavioral functioning, and whether early interventions—as is increasingly suggested (e.g., Dickinson et al., 2010; Lesaux, 2012)—should emphasize preventing or remediating early vocabulary gaps to accelerate at-risk children's developmental trajectories.

Our study therefore has several theoretical and practical implications. We identify by the 24-month time period a wide range of sociodemographic, gestational and birth, family risk and resilience, and child-level factors associated with larger or smaller oral vocabularies that themselves may be included in early screening, monitoring, and intervention efforts. Consistent with prior research (e.g., Fernald et al., 2013; Hart & Risley, 1995), we initially found that family SES initially has a strong, consistent association with 24-month-old children's oral vocabularies. However, and which has been not previously reported, we subsequently found that this association is partially explained by children's own level of behavioral and general cognitive functioning in addition to other factors. Low SES in particular is increasingly recognized as being associated with fewer oral vocabulary-building opportunities (Mani, Mullainathan, Shafir, & Zhao, 2013) and child-directed speech (Weisleder & Fernald, 2013). Our study's findings of low SES's continuing negative relation with oral vocabulary, as well as the uniquely positive relation observed for parenting behaviors that are cognitively stimulating, child centered, and positive, are consistent with these theoretical accounts and suggest that interventions may need to be specifically targeted to 24-month-old children being raised in disadvantaged home environments (Hart & Risley, 1995; Rowe, 2008). Our findings are also consistent with other research indicating that being born with very low birth weight (Stolt, Haataja, Lapinleimu, & Lehtonen, 2008) and being raised in a household with a mentally ill family member (Zajicek-Farber, 2010) may contribute to delays in oral vocabulary acquisition. The negative association with being a nonsingleton is consistent with other work (Hillemeier, Farkas, Morgan, Martin, & Maczuga, 2009) and may result from parents speaking fewer words to each child when they are raising two or more children of the same age. Our findings indicate that the negative association with mental illness may not be unique to maternal depression, which itself is explained by children's own lower behavioral and general cognitive functioning, but may instead be related to a more general set of health and well-being indicators including a family member having a mental illness, being raised by a mother experiencing health problems, and being raised by a mother who feels socially isolated.

Our findings are consistent with prior work hypothesizing that a larger oral vocabulary helps children experience greater achievement and behavior (e.g., Perfetti & Stafura, 2014), thereby increasing the children's educational and societal opportunities as they age (e.g., Hoff, 2013; Lesaux, 2012). However, and across the study's five indicators of academic and behavioral functioning, other factors were also predictive. Consistent with this other work, these other factors included SES, low birth weight, watching television frequently, frequently being in child care (NICHD Early Child Care Research Network, 2003), and children's own prior level of general cognitive functioning. Our study's results extend prior work by suggesting that attending child care may also positively impact children's oral vocabularies. Our findings are consistent with prior work suggesting that parents who are stressed, overburdened, less engaged, and experiencing less social support may less frequently talk, read, or otherwise interact with their children (e.g., Paulson, Keefe, & Leiferman, 2009), resulting in these children having smaller oral vocabularies.

Prior empirical studies have largely been limited to investigations of single developmental pathways between vocabulary and (a) reading achievement, (b) mathematics achievement, or (c) behavioral functioning. Our study extends the field's knowledge base by rigorously establishing that oral vocabulary uniquely predicts multiple developmental pathways simultaneously and that this is evident as children are making the major transition to formal schooling. That oral vocabulary displays both temporal precedence and continued predictive utility despite extensive covariate adjustment across such a diverse number of indicators of children's development functions as a type of internal replication, providing empirical support to oral vocabulary's theorized importance as a first-order factor that may contribute to their early life-course trajectories. Our study also provides additional empirical support for claims that preventing or reducing later academic achievement gaps and their sequela may necessitate special emphasis on increasing at-risk children's oral vocabularies. Such efforts may need to occur before children are 24 months old. This is because oral vocabulary gaps are evident even by this very early time period, and in turn consistently predict children's academic and behavioral functioning as they begin kindergarten in the United States.

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Supporting Information

Additional supporting information may be found in the online version of this article at the publisher's website:

Appendix S1. Note on Oral Vocabulary Terminology

Appendix S2. Additional Knowledge Base Limitations

Appendix S3. Multiplicity Check Information