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Authors

Hammer, Carol
Morgan, Paul
Farkas, George
et al.

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Research Article

Late Talkers: A Population-Based Study of Risk Factors and School Readiness Consequences

Carol Scheffner Hammer,[a] Paul Morgan,[b] George Farkas,[c] Marianne Hillemeier,[b] Dana Bitetti,[d] and Steve Maczuga[b]

Purpose: This study was designed to (a) identify sociodemographic, pregnancy and birth, family health, and parenting and child care risk factors for being a late talker at 24 months of age; (b) determine whether late talkers continue to have low vocabulary at 48 months; and (c) investigate whether being a late talker plays a unique role in children's school readiness at 60 months.
Method: We analyzed data from the Early Childhood Longitudinal Study, a population-based sample of 9,600 children. Data were gathered when the children were 9, 24, 48, and 60 months old.
Results: The risk of being a late talker at 24 months was significantly associated with being a boy, lower socioeconomic status, being a nonsingleton, older maternal age at birth, moderately low birth weight, lower quality parenting, receipt of day care for less than 10 hr/week, and attention problems. Being a late talker increased children's risk of having low vocabulary at 48 months and low school readiness at 60 months. Family socioeconomic status had the largest and most profound effect on children's school readiness.
Conclusions: Limited vocabulary knowledge at 24 and 48 months is uniquely predictive of later school readiness. Young children with low vocabularies require additional supports prior to school entry.

It is well established that children's language abilities are critical to their academic success. Studies have consistently shown that language supports children's reading abilities in early and later grades (Catts, Fey, Tomblin, & Zhang, 2002; National Institute of Child Health and Human Development [NICHD] Early Child Care Research Network, 2005; Scarborough, 2001; Storch & Whitehurst, 2002). Children with stronger language abilities, and in particular larger vocabularies, have better reading comprehension and decoding skills than children with weaker language abilities (Braze, Tabor, Shankweiler, & Mencl, 2007; Schatschneider, Fletcher, Francis, Carlson, & Foorman, 2004; Verhoeven & Van Leeuwe, 2008). Although less well studied, investigations have also demonstrated significant relations between language and children's mathematical abilities (Jordan, Levine, & Huttenlocher, 1995; Pappas, Ginsburg, & Jiang, 2003; Purpura, Hume, Sims, & Lonigan, 2011). Larger vocabularies have been associated with number naming abilities, knowledge of measurement and shapes, and geometry and the ability to manipulate symbolic representations (Hornung, Schiltz, Brunner, & Martin, 2014; Vukovic & Lesaux, 2013). In addition, language abilities have been found to promote children's behavioral functioning. For example, children with stronger language are better able to communicate with teachers and peers and to regulate their behavior and emotions (Carson, Klee, Lee, Williams, & Perry, 1998; Cole, Armstrong, & Pemberton, 2010; Menting, Van Lier, & Koot, 2010; Qi & Kaiser, 2004).

Because of the importance of language, efforts have been made to identify children who may be at risk for learning difficulties early in life. Much attention has been given to late talkers or children who have limited expressive vocabularies at 2 years of age. Interest in this group of children began 15 to 20 years ago with the seminal works of Thal and Bates (Thal, 1991; Thal & Bates, 1988), Paul (1991, 1993), and Rescorla and colleagues (Rescorla & Merrin, 1998; Rescorla, Roberts, & Dahlsgaard, 1997). Since work in this area began, researchers have attempted to identify factors that place children at risk for being late talkers and have investigated late talkers' long-term outcomes.

[a]Teachers College, Columbia University, University Park, NY
[b]The Pennsylvania State University, University Park
[c]University of California, Irvine
[d]Temple University, Philadelphia, PA
Dana Bitetti is now at La Salle University, Philadelphia, PA.
Correspondence to Carol Scheffner Hammer: carol.hammer@tc.columbia.edu

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Despite this work's many contributions, it has been difficult to generalize their findings to the larger population of U.S. children. This is because the majority of studies involve clinical samples with relatively small numbers of participants, limited diversity in terms of socioeconomic status (SES), and unspecified racial or ethnic identities (Bavin & Bretherton, 2013). For example, Thal and Bates (Thal, 1991; Thal & Bates, 1988) studied the development of 10 late talkers and 10 language-matched peers (SES not provided). Paul (Paul & Fountain, 1999; Paul & Shiffer, 1991) investigated 36 late talkers from primarily middle-SES homes. Rescorla and colleagues (Rescorla & Merrin, 1998; Rescorla, Roberts, & Dahlsgaard, 1997) followed the language development of 34 late talkers and 21 typically developing children of middle and upper-middle SES. Population-based studies are needed to better understand the risk factors for being a late talker as well as whether and to what extent late taking may interfere with children's school readiness.

To date, several community-based and population-based studies have been conducted. Two took place in Australia: (a) the Randomly Ascertained Sample of Children born in Australia's Largest State (RASCL), a longitudinal study of 2,224 children from birth through 8 years of age (cf. Rice, Taylor, & Zubrick, 2008; Zubrick, Taylor, Rice, & Slegers, 2007), and (b) the Early Language in Victoria Study, a longitudinal study of 1,911 children from birth through age 4 years, which also included children learning English as a second language (cf. Reilly et al., 2006, 2010). Others were conducted in the Netherlands, Sweden, Demark, and England and Wales. The study conducted in the Netherlands was titled "Generation R," which was a longitudinal study of more than 3,700 children who were assessed at 18 months and during the preschool years (Henrichs et al., 2011, 2013). The Swedish study involved more than 1,500 children who were recruited at birth (Westerlund & Lagerberg, 2008). The study in Denmark was a cross-sectional study of children at 2 and 3 years of age (Bleses & Vach, 2013; note that middle-SES families were overrepresented in this study). The Twins Early Development Study (TEDS), which was carried out in England and Wales, was a longitudinal study of twins who were followed from birth through age 12 years (cf. Dale, Harlaar, Hayiou-Thomas, & Plomin, 2010; Dale et al., 1998). In addition, data from the NICHD Early Child Care Study, a birth cohort study conducted in the United States, have been used to investigate children's vocabulary delays at 3 years of age and beyond (La Paro, Justice, Skibbe, & Pianta, 2004).

In general, these studies identified potential risk factors for being a late talker, although the specific risk factors considered and the number of factors included in the analyses varied across the studies. Being a boy and of low SES were identified as risk factors for late talking in most of the studies. Low birth weight was found to be a factor in one of the three studies that considered it. Preterm birth was identified in one of two studies that investigated this factor. Low maternal age was found to be factor in being a late talker in the Swedish study but not in the RASCL study. Also, family history of language difficulties was a significant factor in three studies that included this variable in the analyses. Complementing this finding, TEDS found a genetic component to late talking. TEDS and Generation R also found a relationship between late talking and externalizing problems. One or two studies tested the following possible risk factors, which were not found to be significantly related to being a late talker at 18 to 24 months: maternal mental health, maternal behavioral risk factors (e.g., cigarette smoking), quality of parenting, and attendance in day care. The studies that followed children into their school years found that late talkers display later language abilities at the lower end of the typical range, with a subset of these children showing specific language impairment (SLI; Dale & Hayiou-Thomas, 2013; Rice et al., 2008).

Although these studies have made valuable contributions, additional research is needed for several reasons. First, most of these studies took place outside of the United States. This, of course, is not by itself a limitation; however, the United States differs from European countries and Australia in many ways, including its racial and ethnic diversity and its educational, medical, and political contexts that can affect children's development. Thus, a study conducted on a sample from the United States would broaden the field's understanding of the effect of being a late talker in a more diverse context. Second, three of the studies—the RASCL, Early Language in Victoria, and Denmark studies—focused on children's later development of their language abilities but not academic achievement or school readiness. It is important to understand whether being a late talker is a factor that affects children's school readiness and academic outcomes given that academic success is critical for children's future well-being. Third, the Early Language in Victoria, TEDS, and Denmark studies investigated a relatively limited set of characteristics when identifying risk factors for low vocabulary at 24 months. An increased understanding is needed of the role that various demographic, neurodevelopmental, maternal, and environmental factors and parenting and child care experiences may have in placing children at risk for being a late talker and the effect these may have on children's later development (Bavin & Bretherton, 2013; Bleses & Vach, 2013). This study was designed to address these needs. The study (a) involved a population-based sample from the United States, (b) included a large number of potential risk factors associated with late talking and later school readiness skills that have been implicated in the literature, and (c) focused on the unique role of late talking in school readiness by targeting children's language, literacy, math, and socioemotional outcomes at 48 and 60 months of age.

Risk Factors Affecting Development

A number of factors may place children at risk for being a late talker at age 2 years and may affect children's vocabulary, reading, math, and behavioral abilities during the preschool years. These include sociodemographic factors, pregnancy and birth characteristics, family health and family history of learning problems, parenting and child care, and early behavioral functioning. Many of these factors

have been targeted in various studies, which typically have involved relatively small samples and/or have followed children for a relatively short time period. To our knowledge, no study has simultaneously examined all of these factors in a single longitudinal investigation of late talkers. Investigating these factors simultaneously allows for more accurate estimation of the risk uniquely attributable to any one factor, thereby helping to better establish whether the factor should be the target of early screening and intervention efforts.

Sociodemographic Factors

One key sociodemographic factor is gender, which has been identified as a risk factor for being a late talker as well as for reading disabilities in numerous studies. Boys appear to be at greater risk than girls for low vocabulary early in life (Bavin & Bretherton, 2013; Dale & Hayiou-Thomas, 2013; Zubrick et al., 2007). For example, in their population-based study, Zubrick et al. (2007) found that boys were nearly three times more likely to be a late talker than girls; however, Reilly et al. (2007) did not find an effect of gender on late talking status at 24 months of age. Other studies have found boys to be at higher risk for low language during the preschool years (cf. Harrison & McLeod, 2010; Maatta, Laakso, & Tolvanen, 2012). Additional studies have shown that girls have stronger reading abilities than boys. For example, data from the Early Childhood Longitudinal Study–Kindergarten Cohort showed that girls entered kindergarten with stronger literacy skills (Ready, LoGerfo, Burkham, & Lee, 2005). In addition, gender has been found to be a predictor of reading achievement in early grades (Campisi, Serbin, Stack, Schwartzman, & Ledingham, 2009). Less is known about the role of gender in early math or behavioral abilities.

SES and related factors have also been implicated as risk factors in the Early Language in Victoria and TEDS studies of late talkers and in studies of children's academic abilities (Bavin & Bretherton, 2013; Dale & Hayiou-Thomas, 2013; Fernald, Marchman, & Weisleder, 2013). It must be noted, however, that economic disadvantage was not found to be a factor in the RASCL study (Zubrick et al., 2007) or the Early Language in Victoria Study (Reilly et al., 2007). Zubrick et al. (2007) argued that neurobiological and genetic factors operate across families of varying sociodemographic characteristics. Others studies that have found that genetic factors play a role assert that the shared environment of parents and children can also influence language development (Dale, Tosto, Hayiou-Thomas, & Plomin, 2015).

Nonetheless, research has consistently shown that children from low-SES homes leave preschool with vocabulary, reading, and math abilities that are below those of their peers from middle-SES homes (Aikens, Kopack Klein, Tarullo, & West, 2013; Jordan & Levine, 2009). Likewise, the National Center for Education Statistics (NCES) has documented that children of low SES score lower than children of middle SES on reading and math assessments throughout their educational careers (NCES, 2014).

Children's race/ethnicity is another factor that needs to be considered, although the findings in this research area are also inconsistent. In a study of late talkers, Poll and Miller (2013) did not observe an effect of race on children's language abilities, nor did Nelson, Welsh, Trup, and Greenberg (2011) in their study of the prevalence of language delay in Head Start children. Likewise, Horwitz et al. (2003) reported that non-White children had a relatively low risk for language delay compared with White children. However, La Paro et al. (2004) found that African American children with a language impairment at age 3 years were 13 times more likely than their White peers to continue to have a language impairment at 54 months of age. When maternal sensitivity and warmth were taken into account, this effect disappeared.

A significant effect of race/ethnicity on children's reading and math abilities has been observed. For example, data from NCES show that African American and Hispanic children are more likely to score lower than White children in reading and math as they progress through school. However, larger percentages of African American and Hispanic children come from families of low SES compared with White children. Thus, race and SES may be confounded in these findings.

Pregnancy and Birth Characteristics

Pregnancy and birth characteristics that may affect children's abilities include maternal age, low birth weight, being a twin, medical and behavioral risks during pregnancy, and complications during delivery. For example, older maternal age at children's birth has been related to SLI (Delgado, Vagi, & Scott, 2007) but not to late talker status (Reilly et al., 2007; Zubrick et al., 2007). Low birth weight has been associated with being a late talker (Rescorla, 2013), lower cognitive functioning (Hack, Taylor, & Klein, 1995), poorer academic abilities at school entry (Lynch, 2011), and impairments in self-regulation (Klebanov, Brooks-Gunn, & McCormick, 2001). Being a twin places children at greater risk for being a late talker (Reilly et al., 2007) and having lower language abilities (Bishop, Price, Dale, & Plomin, 2003; Rutter, Thorpe, Greenwood, Northstone, & Golding, 2003); the risk is higher for monozygotic twins (as opposed to dizygotic twins; Rice, Zubrick, Taylor, Gayan, & Bontempo, 2014).

The evidence on the role of medical and behavioral risks in children's language and academic outcomes is mixed. Some studies have found that maternal medical risks and behavioral risks affect children's language development and academic abilities (Anthopolos, Edwards, & Miranda, 2013; Cho, Frijters, Zhang, Miller, & Gruen, 2013; Delgado, Vagi, & Scott, 2005; Goldschmidt, Richardson, Cornelius, & Day, 2004; Mensah & Kiernan, 2011). However, the effect of these risks may be accounted for by SES status (Batsrta, Hadders-Algra, & Neeleman, 2003; Ellingson, Goodnight, Van Hulle, Waldman, & D'Onofrio, 2014; Gilman, Gardener, & Buka, 2008).

Family Health and History

Characteristics of the family, such as maternal physical and mental health and family history of mental and learning

difficulties, may also affect children's development. In regard to maternal physical health, one study found that mothers' general health affected children's language, literacy, and math abilities at 3 years of age (Mensah & Kiernan, 2011). Findings on maternal mental health (i.e., maternal depression and isolation) have yielded inconsistent results, although few studies have investigated this relationship. For example, maternal depression has not been implicated as a factor in late talking (Bavin & Bretherton, 2013; Zubrick et al., 2007); however, investigations of children's language development during the toddler and preschool years have shown that children of depressed mothers have slower language growth than children of nondepressed mothers (Brennan et al., 2000; Horwitz et al., 2003; Murray, 1992; NICHD Early Child Care Research Network, 1999; Pan, Rowe, Singer, & Snow, 2005). Also, the effects of maternal depression have been observed on children's cognitive development, literacy abilities, and behavioral functioning (Baker & Iruka, 2013; Elgar, McGrath, Waschbusch, Stewart, & Curtis, 2004; Harrison & McLeod, 2010; Hay et al., 2001; Herwig, Wirtz, & Bengel, 2004; La Paro et al., 2004).

Having a family member with a learning disability or special needs is a possible risk factor. Having a family member with delayed language has been associated with language delays in children in several studies (Bavin & Bretherton, 2013; Flax, Realpe-Bonilla, Roesler, Choudhury, & Benasich, 2008; Dale et al., 2010, 2015; Spinath, Price, Dale, & Plomin, 2004; Ukoumunne et al., 2012; Zubrick et al., 2007).

Parenting and Child Care

Parenting and attendance in child care may also affect children's development. Parenting quality has been shown to mediate the effects of SES on development (Conger & Donnellan, 2007; Guo & Harris, 2000; Yeung, Linver, & Brooks-Gunn, 2002). Children of parents who are warm and nurturing, provide cognitively stimulating environments, and establish routines for their children have higher cognitive, academic, and behavioral functioning (Crosnoe, Leventhal, Wirth, Pierce, & Pianta, 2010; Iruka, LaForett, & Odom, 2012). However, Zubrick et al. (2007) did not find a relationship between parenting quality and late talking.

Overall, studies investigating the effect of child care on development have identified a positive association of child care attendance and children's language, literacy, and math outcomes in early childhood and beyond. For example, Vallotton et al. (2012) found that participation in Early Head Start programs promoted boys' and girls' vocabulary development and appeared to buffer the effects of parenting stress on language development. Other studies have also shown that quantity and quality child care improves children cognitive, language, and academic outcomes (Hall et al., 2009; Melhuish, Belsky, & Leyland, 2008; NICHD Early Child Care Research Network, 2000, 2002, 2003; Vandell, Belsky, Burchinal, Steinberg, & Vandergrift, 2010). This benefit is particularly strong for children of low-SES homes, particularly when the level of cognitive stimulation is consistent between home and child care (Chazan-Cohen & Kisker, 2013; Crosnoe et al., 2010). The benefits of quality parenting and child care were observed in children's reading and math scores in first, third, and fifth grades.

Early Behavioral Functioning of Children

Children's early behavioral functioning may also have an effect on early language and later academic outcomes, although the findings thus far have been mixed. For example, Henrichs et al. (2011) found that children with expressive vocabulary delay at 18 months were significantly more likely to be rated by their mothers as having either externalizing or internalizing problems; however, the authors noted that the effect sizes were small and concluded that the relationship between early vocabulary and behavioral problems may not be causal. Likewise, Horwitz et al. (2003) observed that when children's social competence was accounted for, the relationship between language delay and behavioral problems no longer existed.

Studies of children's later language, literacy, and math abilities have found positive associations between children's development and their behavioral functioning, however. Examples of this include studies of growth in children's approaches to learning (i.e., inhibitory control, attention, and working memory) and in children's vocabulary, reading, and math (Dobbs, Doctoroff, Fisher, & Arnold, 2006; Li-Grining, Votruba-Drzal, Maldonado-Carreño, & Haas, 2010; McClelland et al., 2007; von Suchodoletz & Gunzenhauser, 2013). There is some evidence to suggest that internalizing problems are associated with lower vocabulary in boys at age 3 years (Henrichs et al., 2013). In addition, the co-occurrence of attention-deficit/hyperactivity disorder (ADHD) and SLI is estimated to between 30% and 50% (Redmond, 2016). However, the relation among attention difficulties, language abilities, and reading is unclear. Tomblin, Zhang, Buckwalter, and Catts (2000) found that reading disabilities were a mediator between language impairment and ADHD, whereas McGinty and Justice (2009) found that reading disabilities served as a moderator. Redmond, Hogan, Ash, and Guarino (2014) did not observe either a mediating or moderating role but instead found that language impairment and ADHD were distinct risk factors for reading disabilities. Redmond (2016) concluded that differences in the compositions of the samples, the scales used to measure ADHD, and the ages of the participants made it difficult to reconcile the discrepant findings.

Additional evidence shows that externalizing problems are related to lower language, reading, and math problems in early grades (Bulotsky-Shearer & Fantuzzo, 2011; Bulotsky-Shearer, Fernandez, Dominguez, & Rouse, 2011; Carpenter & Drabick, 2011; Harrison & McLeod, 2010; Oliver, Dale, & Plomin, 2004). However, Oliver et al. (2004) concluded that early language abilities were a stronger predictor of later language difficulties than were behavioral problems.

Purpose of the Study

In this study, we sought to identify the risks for being a late talker (defined as having a low expressive vocabulary

at 24 months) and to determine whether being a late talker had a negative effect on children's school readiness. We used data from the Early Childhood Longitudinal Study, Birth Cohort (ECLS-B), a large nationally representative sample, to address gaps in the existing literature. The use of this large national database permitted us to examine the unique role of a large number of possible factors in late talking and children's later school readiness and to do so with data permitting generalizations to the general population. Three questions were addressed:

1. What are the risk factors for being a late talker at 24 months of age?
2. Do late talkers continue to have low vocabulary at 48 months of age?
3. Does being a late talker at 24 months of age play a unique role in children's school readiness, as defined by reading, math, and behavioral functioning at 60 months of age?

Method

Data and Analytic Sample

Data for this study came from the ECLS-B conducted by NCES. The ECLS-B began in 2001 with a population-representative cohort of infants selected from U.S. birth certificate files. The cohort included oversamples of Asian and Pacific Islanders, Native Americans and Alaska Natives, infants born at moderately low (1,500–2,500 g) and very low (< 1,500 g) birth weight, and multiple births. More information about the ECLS-B is available at http://nces.ed.gov/ECLS/birth. Sampling weights provided in the data set permit population-based estimates.

This study focuses on children who were either late talkers or not and who had otherwise typical development at 24 months of age. We classified children as being late talkers if their expressive vocabulary scores fell within the lowest 10% of the sample score distribution as measured by the MacArthur Communicative Development Inventory (M-CDI; Fenson et al., 1993). This classification is consistent with previous studies of late talkers (Dale et al., 2010; Dollaghan, 2013; Fenson et al., 1994; Weismer, 2006).

Children with missing M-CDI data were excluded from the sample, as were those who were younger than 22 months or older than 26 months at the time of assessment. Because we were interested in examining outcomes of children who were otherwise typically developing, those with very low birth weight or congenital anomalies were omitted from the sample. Also, children were omitted if their parents answered that a language other than English was the primary language in the home when responding to the question "What is the primary language spoken in your home?" This is due to potential differences between the English language development of monolingual and bilingual children.

After these exclusions, the analytic sample at 24 months included 6,050 children. (Note that all sample sizes are rounded to the nearest 50 per ECLS-B confidentiality requirements.) For the 48-month analyses, children with missing data on the outcome of interest—receptive vocabulary—were excluded, yielding a sample size of 5,450. At 60 months, the analyses included 4,200 children with data on the reading and math assessments. The final set of analyses included 3,000 children with kindergarten teacher reports of approaches to learning and externalizing and internalizing behaviors at 60 months. Missing data on independent variables in each of the multivariate analyses were imputed using multiple imputation procedures in SAS Version 9.3 (SAS Institute, Cary, NC).

Procedure

ECLS-B staff conducted in-person assessments of children's cognitive and behavioral functioning when the children were 9, 24, and 48 months of age. Interviews with the children's mothers were also conducted at these time points. Children's behavior was rated at 60 months of age by their kindergarten teachers.

It is well known that, on average, girls' vocabulary and reading performance develops more rapidly than that of boys. It is also known that girls tend to exhibit fewer behavior problems than boys. As a result, it is common to use gender-specific norms when deciding whether a child has either a vocabulary or a behavior problem. In order to test the robustness of our findings to the use of gender-specific norms, we have reported all our analyses in two forms. In one of these, late talkers at 24 months, low vocabulary at 48 months, low reading performance at 60 months, and behavior problems at 24 and/or 60 months were defined (separately for boys and girls) as the members of each group falling into the lowest performing 10% of the students. We refer to these as *gender-specific norms* (cutoffs). As an alternative, for each of these variables, we used the lowest performing 10% of the full sample (boys and girls combined) as the cutoff. We refer to these as *overall sample norms* (cutoffs). Our principal substantive findings were unaffected by which definitions were used in the analyses.

Independent Variables

Sociodemographic Characteristics

Data were analyzed from maternal interviews and birth certificate files regarding race/ethnicity (non-Hispanic White, non-Hispanic African American, Hispanic, other race/ethnicity), child age, gender, maternal marital status, and SES at the 24-month assessment. An SES index was calculated by ECLS-B staff using a composite of father's and mother's education, father's and mother's occupation, and household income. In cases in which only one parent was in the household, the SES index was computed using the information that was available on that parent. For this study, the SES index scores were divided into quintiles and represented in multivariate analyses as a set of four dummy variables.

Pregnancy and Birth Characteristics

Children were characterized as nonsingletons if they were the product of a twin or higher order pregnancy. Maternal age at the child's birth was classified as < 18, 18 to 35, or > 35 years of age. Birth weight between 1,500 and 2,500 g was identified with a dichotomous variable for moderately low birth weight.

Complications of labor were taken into account with a count variable that included abruptio placenta, anesthetic complications, dysfunctional labor, breech or malpresentation, cephalopelvic disproportion, cord prolapse, fetal distress, excessive bleeding, fever > 100 °F, moderate or heavy meconium, precipitous labor (< 3 hr), prolonged labor (> 24 hr), placenta previa, or seizures during labor. The total number possible was 14. We also included a count of obstetrical procedures (range: 0–5), including induction of labor, stimulation of labor, tocolysis, amniocentesis, and cesarean section.

A count of medical risk factors 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 (range: 0–16). Behavioral risk factors during pregnancy, including alcohol and/or tobacco, use were summed to form a scale ranging from 0 to 2.

Family Health and Well-Being

Interviews with mothers elicited information about the well-being of family members. In our analyses, we include dichotomous variables to indicate the presence of the following conditions among a parent or other family member: mental illness; learning disability; or special need, delay, or disability. During the 24-month interview, mothers indicated if they had medical conditions including asthma, allergies, and diabetes. They also completed a modified version of the Center for Epidemiologic Studies–Depression Scale at the 24-month assessment. This scale consisted of 12 items related to depression; each item was rated on a 4-point scale. Scores were dichotomized such that mothers with a score of > 24 were identified as having high levels of depression. Mothers also answered five questions related to social isolation at the 24-month assessment. The first three questions asked whom the respondents would ask for help in certain situations, and the others asked whether they attended religious services and whether they were emotionally close to their own mothers. A response of *no one* to any of the first three questions and a response of *no* to either or both of the last two questions were considered to indicate maternal isolation.

Parenting

Parenting quality was indexed by the average of scores on two parenting assessments administered at 24 months. The first was a modified version of the Home Observation for Measurement of the Environment (Caldwell & Bradley, 1984). This assessment measured activities done with children such as reading to the child, telling stories, singing, and going on outings; the presence of toys, records, books, and audiotapes in the home; and safety and supportiveness of the home environment. A total count of the Home Observation for Measurement of the Environment items was computed. The second measure of parenting was based on videotaped interactions during the Two Bags Task, a simplified version of the Three Bags Task that has been used in previous research, including the Early Head Start Research and Evaluation Project and the NICHD Study of Early Child Care (Nord, Edwards, Andreassen, Green, & Wallner-Allen, 2006). Parents were asked to play with their children for 10 min using a children's picture book and a set of toy dishes. A parenting support variable was created by ECLS-B staff that consisted of the mean score for three aspects of parent–child interaction: parental sensitivity, stimulation of child cognitive development, and parental positive regard (e.g., warmth, responsiveness). Each of these parenting characteristics was scored from 1 (*very low*) to 7 (*very high*).

Center-Based Child Care

At the 24-month assessment, mothers were asked how many hours per week their children spent in center-based child care. At the 48-month assessment, mothers indicated how many hours per week their children spent in center-based child care and in Head Start. A dichotomous variable was created to indicate children who spent more than 10 hr/week in these settings.

Behavioral Problems

Data collectors rated the children's behavior using the Behavior Rating Scale (BRS) Research Edition during the 24-month assessment. The BRS Research Edition, which was adapted from the BRS (Bayley, 1993), contains 11 items from the full BRS. These items included cooperation with the data collector, attention to the task, interest in the materials, persistence, and frustration with the tasks presented (Nord et al., 2006). Data collectors rated children's behavior on a 5-point scale. Specific items were reverse coded to be consistent with other "appropriate" behaviors.

We used eight items from the BRS Research Edition to measure behavioral functioning. Self-regulation was measured by four items (e.g., attention to tasks, persistence). Externalizing and internalizing behaviors were measured by two items, respectively: frustration and cooperation, and fearlessness and social engagement. Crombach's α for the behavioral variables were .90, .64, and .72. Both gender-specific and sample-wide 10% cutoffs were used to infer that a student experienced one of the problems.

Outcome Variables

Late Talker at 24 Months

Children's vocabulary was assessed during interviews with the children's mothers at 24 months of age using a modified version of the M-CDI that was developed by

Dale and Marchman for use in the ECLS-B. Mothers were asked whether their children could say each of 50 words and phrases commonly known and spoken at 24 months, such as *mommy, meow, thank you,* and *all gone*. The numbers of words reported were summed to create a total word score. The M-CDI vocabulary assessment has high internal consistency ($\alpha = .96$), and this assessment has been found to classify children into language status groups with 97% accuracy (Skarakis-Doyle, Campbell, & Dempsey, 2009). In this study, using the total sample, children whose scores were in the lowest 10% of the sample score distribution (i.e., ≤13 words) were considered to be late talkers. We used both gender-specific and overall-sample 10% cutoffs in the analyses. For boys the 10% cutoff was 10 words, and for girls the cutoff was 17 words. The overall-sample cutoff was 13 words.

Vocabulary at 48 Months

Children's vocabulary at 48 months was assessed with a modified version of the Peabody Picture Vocabulary Test (PPVT; Dunn & Dunn, 1997). The PPVT is widely used and has high reliability values (i.e., .92–.93). Consistent with prior studies (e.g., Webster, Majnemer, Platt, & Shevell, 2004), we identified children scoring in the bottom 10% of the overall PPVT score distribution at 48 months as having low vocabulary. As with the late talker variable, we also found separate 10% cutoffs for each gender and coded the low vocabulary at 48 months separately depending on the child's gender. Both sets of analyses are reported in the tables.

Reading and Mathematics Scores at 60 Months

At 60 months, children were given (a) a reading test consisting of 74 items assessing basic skills (i.e., letter recognition, letter sounds, early reading, phonological awareness, print conventions, and word matching), reading comprehension, and vocabulary and (b) a mathematics test with 42 items assessing number sense, counting, operations, geometry, patterns, and measurement. For each of these assessments, all children were given the same 24-question core test, and additional items were chosen for administration depending on whether they scored in the low, middle, or high range on the core items. The reading and mathematics tests display high reliability, with theta reliability coefficients of .92 (Najarian, Snow, Lennon, Kinsey, & Mulligan, 2010). In our analyses, we identified children scoring in the bottom 10% of the distribution, both for the sample as a whole and for each gender separately, as displaying low reading and mathematics achievement.

Approaches to Learning, Externalizing, and Internalizing Problems at 60 Months

Twenty-two behavioral assessment items were derived from several sources that included the Preschool Learning and Behavior Scales–Second Edition (Merrell, 2002); the Social Skills Rating System (Gresham & Elliot, 1990); and learning behavior items used in the Early Childhood Longitudinal Study, Kindergarten Class of 1998–1999. Teachers rated the frequency of each behavior on a 5-point scale from 1 (*never*) to 5 (*very often*). On the basis of the 22 behaviors from these assessments, we conducted an exploratory factor analysis using a promax rotation, retaining a four-factor solution after examining several potential factor solutions and considering a priori criteria (Tabachnick & Fidell, 2007). Items that reduced internal consistency and had factor loadings of .60 or lower were removed. We identified items in three of the four factors as relevant to the present study. The first scale described approaches to learning ($\alpha = .91$), which included five items: shows eagerness to learn, pays attention well, works/plays independently, keeps working until finished, and has difficulty concentrating. The second scale captured externalizing behavior problems ($\alpha = .87$), including disrupts others, has temper tantrums, is physically aggressive, and annoys other children. The third scale identified internalizing behavior problems ($\alpha = .64$), which included seems unhappy, worries about things, and acts shy. Items in each of these scales were summed to obtain scale scores.

Children scoring in the bottom 10% of the distribution for approaches to learning were identified as having approaches to learning problems. Those scoring in the top 10% of the distributions for externalizing and internalizing behaviors were considered to exhibit externalizing and internalizing behavior problems, respectively. As with other variables, these cutoffs were computed both for the total sample and for each gender separately, and both sets of analyses were reported.

Analyses

Descriptive statistics for study variables, including percentage or mean and standard deviation, were calculated using sampling weights provided in the ECLS-B data set. Using multiple logistic regression, a set of three models was estimated to identify the odds of being a late talker at 24 months. Model 1 estimated the extent to which sociodemographic characteristics, including race/ethnicity, age, gender, and SES, functioned as predictors. Model 2 added additional variables related to nonsingleton birth, maternal age, and marital status. Model 3 added pregnancy, labor, and birth-related characteristics; family health, parenting, and child care variables; and child behavioral variables to the regression model. All analyses were run twice—once with gender-specific cutoffs for late talker and low 48-month vocabulary and once with a single sample-wide 10% cutoff for these variables. We also added a Gender × Child Age interaction to allow for gender-specific rates of vocabulary growth. In addition, interactions between child gender (male) and age, gender and SES, gender and nonsingleton, and SES and child care were investigated; however, because none of these were significant, they are not included in the final results.

Following this, sets of multivariate logistic regression models were estimated to predict the odds of having low receptive vocabulary at 48 months, low reading score at 60 months, low math score at 60 months, and behavioral

problems at 60 months (i.e., problems with approaches to learning, externalizing problems, and internalizing problems). These regressions were similar to those above. However, the regressions for low reading and low math scores at 60 months included low vocabulary at 48 months (defined both with an overall sample and gender-specific cutoff as the lowest 10% of the children) and tested for an interaction between late talking at 24 months and low vocabulary at 48 months in Model 1. We also tested for the following interactions: gender and age, gender and SES, gender and nonsingleton, and SES and child care in the regressions predicting 24-month late talker and 48-month low vocabulary; however, none were significant. Our logistic regressions also included pseudo multiple correlation squared measures appropriate for binary outcomes. Because these are not directly comparable to multiple correlation squared measures when the dependent variable is continuous, such as those in the articles by Henrichs et al. (2011, 2013), we were not able to compare the variance explained in our regressions with the multiple correlation squared reported in those articles.

Results

Table 1 shows descriptive statistics for the overall analysis sample with complete data, including the children's parent-reported word score at 24 months (n = 6,050). The table also shows the mean 48-month receptive vocabulary score for children with nonmissing scores (n = 5,450), the mean 60-month reading and math scores for those with nonmissing scores (n = 4,200), and the mean 60-month approaches to learning, internalizing, and externalizing scores with nonmissing scores (n = 3,000).

Table 1. Description of analysis population (N = 6,050).

Variable	*M* (*SD*)	%
White		65.1
African American		15.8
Hispanic		12.7
Other race		6.3
Child age	24.2 (0.7)	
Male		51.0
Lowest SES quintile		14.4
Second-lowest SES quintile		18.4
Middle SES quintile		21.4
Second-highest SES quintile		23.1
Highest SES quintile		22.7
Nonsingleton		3.2
Mother's age > 35 years at child's birth		14.4
Mother's age ≤ 18 years at child's birth		7.0
Mother not married, 24 months		31.3
Moderately low birth weight		6.5
Labor complications		29.2
Obstetric procedures		49.8
Medical risk factors in pregnancy		16.1
Behavioral risk factors in pregnancy		13.1
Family member with mental illness		12.5
Family member with learning disability		18.0
Maternal health problems, 9 months		6.9
Household has person with special needs		8.3
Mother depressed, 9 months		9.6
Mother isolated, 9 months		29.4
Parenting score, 24 months	7.5 (1.1)	
Child in child care center > 10 hr/week, 24 months		15.7
Approaches to learning problems, 24 months		9.1
Internalizing problems, 24 months		12.5
Externalizing problems, 24 months		8.2
Child in child care center > 10 hr/wk, 48 months[a]		55.0
Child in Head Start > 10 hr/week, 48 months[a]		17.0
Word score, 24 months	29.3 (11.7)	
Receptive vocabulary score, 48 months[a]	8.8 (1.9)	
Reading score, 60 months[b]	39.0 (14.4)	
Math score, 60 months[b]	40.8 (10.3)	
Approaches to learning scale score, 60 months[b]	18.6 (2.5)	
Internalizing scale score, 60 months[c]	7.1 (3.2)	
Externalizing scale score, 60 months[c]	6.3 (2.2)	

Note. All sample sizes are rounded to the nearest 50 per Early Childhood Longitudinal Study, Birth Cohort confidentiality requirements. Weighted. SES = socioeconomic status.
[a]n = 5,450. [b]n = 4,200. [c]n = 3,000.

Risk and Protective Factors Related to Being a Late Talker

Table 2 reports odds ratio coefficients from the logistic regressions, sequentially adding predictors of a child's chance of being a late talker. The first three of these use gender-specific norms; the second three use an overall sample-wide cutoff. Note that significant odds ratios that are greater than 1.0 indicate increased odds of being a late talker, whereas ratios that are less than 1.0 indicate reduced odds of this outcome.

Model 1 used basic sociodemographics—race/ethnicity, the child's age in months, gender, and SES quintiles—as predictors. Beginning with Model 1 of the gender-specific cutoffs, the results showed that older children are less likely than younger children to be late talkers at 24 months of age (an odds ratio of 0.74:1 for a 1 *SD* increase in the child's age at testing). There was also a strong and monotonically declining relationship of SES quintiles with being a late talker. Children in families in the lowest quintile had an odds ratio of being a late talker that was almost double (1.93:1) that of children from families in the highest quintile. Model 2 added additional sociodemographic variables to the prediction equation. Being a nonsingleton birth (i.e., having a twin), and having an older mother both increased the odds of being a late talker. Adding these variables as controls did not change the child age and family SES effects.

Model 3 added gestational and birth, family, parenting, child care, and child behavioral variables to the equation. These additional predictors explained much of the SES effect on being a late talker. (Note that the statistical significance of this mediation was confirmed with a Sobel test.) Significant effects among these predictors in increasing the odds of being a late talker included the effect of moderately low birth weight and child approaches to learning and internalizing problems. Higher quality parenting and the child attending day care for more than 10 hr/week decreased the odds of being a late talker. The child behavior problems were measured at the same time (24 months)

Table 2. Odds ratios of being a late talker at 24 months (N = 6,050[a]).

	Gender-specific 10% cutoffs			Overall 10% cutoffs		
Variable	**Model 1**	**Model 2**	**Model 3**	**Model 1**	**Model 2**	**Model 3**
African American	0.82	0.85	0.68*	0.79	0.83	0.63*
Hispanic	0.83	0.87	0.75	0.96	1.01	0.85
Other race	1.40*	1.44*	1.25	1.54*	1.58*	1.30
Child age	0.74***	0.74***	0.73***	0.84	0.84	0.82*
Male	0.88	0.88	0.81	3.02***	3.03***	2.70***
Lowest SES quintile	1.93**	2.33***	1.32	1.85*	2.27***	1.21
Second-lowest SES quintile	1.82***	2.10***	1.44	1.69**	1.97***	1.33
Middle SES quintile	1.54*	1.69**	1.38	1.47	1.61*	1.27
Second-highest SES quintile	1.38	1.45*	1.31	1.24	1.31	1.17
Male × child age, 24 months	0.98	0.97	1.02	0.88	0.88	0.92
Nonsingleton		1.62***	1.14		1.74***	1.48*
Mother's age > 35 years at child's birth		1.37*	1.38*		1.30	1.36
Mother's age ≤ 18 years at child's birth		0.71	0.66		0.73	0.69
Mother not married, 24 months		0.93	0.87		0.87	0.93
Labor complications			1.10			1.12
Obstetric procedures			0.92			0.94
Medical risk factors in pregnancy			0.97			1.04
Behavioral risk factors in pregnancy			0.78			0.69*
Moderately low birth weight			1.72***			1.32
Family member with mental illness			1.04			1.02
Family member with learning disability			1.04			1.32
Household has person with special needs			1.35			0.96
Maternal health problems, 9 months			1.39			1.51
Mother depressed, 9 months			1.13			1.25
Mother isolated, 9 months			1.13			1.27
Parenting score, 24 months			0.69***			0.65***
Child in child care center > 10 hr/week, 24 months			0.59**			0.66*
Approaches to learning problems, 24 months			2.40***			2.71***
Internalizing problems, 24 months			1.35*			1.25
Externalizing problems, 24 months			1.12			1.19
Max-rescaled R^2	0.02	0.04	0.12	0.06	0.07	0.15
Tjur's R^2	0.01	0.02	0.07	0.03	0.04	0.09

Note. Child age and parenting score are standardized with a mean of 0 and an *SD* of 1. SES = socioeconomic status.

[a]Sample size is rounded to the nearest 50 per Early Childhood Longitudinal Study, Birth Cohort confidentiality requirements.

*p < .05. **p < .01. ***p < .001. Weighted regressions.

as late talker, so the direction of causality cannot be determined. However, it is still useful to see that these variables were significantly related even with many other variables controlled.

The final three columns of Table 2 show the results using a sample-wide (rather than gender-specific) cutoff for defining being a late talker at 24 months. As expected, using a sample-wide cutoff showed boys as being much more likely than girls (an odds ratio of about 3 to 1) to be late talkers. The other findings using the gender-specific cutoffs were generally robust to the use of a single sample-wide cutoff. Once again, we found strong SES effects that were largely mediated by control variables such as parenting quality, child care, and the child's approaches to learning (attention).

Persistence of Vocabulary Problems at 48 Months

Using sample-wide cutoffs, we also investigated the extent to which late talkers continued to have vocabulary problems and the extent to which children who were not late talkers were found to have a low receptive vocabulary 2 years later. Eighty-three percent of the sample did not have vocabulary difficulties at 24 or 48 months; however, 8% of these children had a vocabulary problem at 48 months. Of those who were late talkers at 24 months, one fourth continued to have a vocabulary problem at 48 months. This accounted for 2.6% of the total sample.

Role of Being a Late Talker at 24 Months on Vocabulary at 48 Months

Table 3 shows the results of the logistic regressions predicting low vocabulary at 48 months. The first three models used gender-specific cutoffs for 24-month late talker, 48-month low vocabulary, and 24-month child behavior problems, whereas the final three models used sample-wide cutoffs. Model 1 included the following as predictors: being a late talker, race/ethnicity, the child's age at assessment, gender, a Gender × Age interaction, and the SES quintiles. Being a late talker at 24 months was a strong predictor of low vocabulary at 48 months, increasing the odds of this

Table 3. Odds ratios of low vocabulary at 48 months (n = 5,450[a]).

Variable	Gender-specific 10% cutoffs			Overall 10% cutoffs		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Late talker, 24 months	4.27***	4.26***	3.47***	3.71***	3.72***	2.92***
African American	1.14	1.11	0.90	1.19	1.17	0.90
Hispanic	1.67**	1.66**	1.40	1.78***	1.76***	1.44*
Other race	1.02	1.02	0.87	1.07	1.08	0.92
Child age, 24 months	0.92	0.92	0.90	0.85	0.85	0.83*
Male	1.03	1.02	0.96	1.44*	1.44*	1.36*
Lowest SES quintile	5.02***	5.16***	3.11***	4.73***	4.88***	3.14***
Second-lowest SES quintile	2.99***	3.08***	2.11**	2.78***	2.88***	2.10**
Middle SES quintile, 24 months	1.85**	1.91**	1.46	1.79**	1.88**	1.49
Second-highest SES quintile	1.48	1.52	1.37	1.37	1.41	1.27
Male × child age, 24 months	0.86	0.86	0.91	0.95	0.95	1.00
Nonsingleton		0.94	0.85		0.84	0.68**
Mother's age > 35 years at child's birth		1.37	1.43		1.43	1.48*
Mother's age ≤ 18 years at child's birth		1.05	1.04		1.17	1.22
Mother not married, 24 months		1.08	1.05		1.05	1.06
Labor complications			0.84			0.90
Obstetric procedures			1.03			1.08
Medical risk factors in pregnancy			1.15			1.18
Behavioral risk factors in pregnancy			0.87			0.76
Moderately low birth weight			1.19			1.47*
Family member with mental illness			0.93			1.09
Family member with learning disability			0.88			0.87
Household has person with special needs			0.92			1.19
Maternal health problems, 9 months			1.05			1.02
Mother depressed, 9 months			1.17			1.09
Mother isolated, 9 months			1.05			0.93
Parenting score, 24 months			0.74***			0.74***
Child in child care center (not Head Start) > 10 hr/week, 48 months			0.44***			0.46***
Child in Head Start > 10 hr/week, 48 months			0.51***			0.52***
Approaches to learning problems, 24 months			1.91***			2.03***
Internalizing problems, 24 months			1.23			1.55*
Externalizing problems, 24 months			1.44			1.10
Max-rescaled R^2	0.12	0.13	0.19	0.11	0.12	0.18
Tjur's R^2	0.07	0.07	0.12	0.07	0.07	0.12

Note. Child age and parenting scores are standardized with a mean of 0 and an *SD* of 1. SES = socioeconomic status.

[a]Sample size is rounded to the nearest 50 per Early Childhood Longitudinal Study, Birth Cohort confidentiality requirements.

*p < .05. **p < .01. ***p < .001. Weighted regressions.

outcome by a factor of 4.3 in Model 1. Being Hispanic (1.67:1) and low or middle SES compared with high SES also significantly increased these odds (i.e., the lower three quintiles had odds ratios of 5.02:1, 2.99:1, and 1.85:1).

Additional demographics were included in Model 2, but none were significant. Model 3 added gestational and birth conditions, family, child care, and child behavior problems. Significant predictors were parenting, child care, and approaches to learning problems, and these partially explained the SES effects. The final three models used sample-wide rather than gender-specific cutoffs. These results showed the same patterns as were found with gender-specific cutoffs. In particular, the very strong effect of SES on low vocabulary continued to be observed.

Role of Being a Late Talker at 24 Months on School Readiness

Tables 4–7 present the results of logistic regressions predicting low reading and math performance and high behavior problems at 60 months. These models included being a late talker at 24 months, low vocabulary at 48 months, the interaction between these variables as predictors, and behavioral functioning at 24 months and were estimated using both gender-specific and sample-wide cutoffs for late talker and low vocabulary.

Low Reading Performance

Table 4 displays the results for low reading performance at 60 months. As before, similar patterns were observed for both gender-specific and sample-wide cutoffs for late talker and 48-month vocabulary. It is not surprising that low vocabulary at 48 months strongly increased the odds of low reading performance at 60 months. However, even with this variable controlled, being a late talker also increased the odds of low reading at 60 months. This was significant at the .05 level using the overall cutoffs and at the .10 level using gender-specific cutoffs. In addition, even with these controls, low SES had exceptionally powerful effects on low reading, with odds ratios of low vocabulary

Table 4. Odds ratios of low reading performance at 60 months (n = 4,200[a]).

Variable	Gender-specific 10% cutoffs			Overall 10% cutoffs		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Late talker, 24 months	1.61	1.61	1.62	1.78*	1.74*	1.72*
Low receptive vocabulary, 48 months	4.03***	3.99***	3.26***	4.59***	4.49***	3.65***
Late talker, 24 months × low vocabulary, 48 months	0.50	0.51	0.61	0.52	0.54	0.65
African American	1.01	1.02	1.04	1.05	1.11	1.17
Hispanic	1.14	1.13	1.03	0.99	0.99	0.90
Other race	1.56	1.57	1.53	1.68	1.72	1.75
Child age	0.63***	0.63***	0.61***	0.56***	0.56***	0.55***
Male	1.09	1.09	1.05	1.53***	1.53**	1.51**
Lowest SES quintile	7.20***	7.36***	4.80***	7.64***	8.24***	5.18***
Second-lowest SES quintile	4.28***	4.38***	3.02**	4.37***	4.67***	3.08**
Middle SES quintile	3.16***	3.23***	2.65**	3.02***	3.21***	2.61**
Second-highest SES quintile	1.85	1.88	1.64	1.89	1.96	1.71
Male × child age, 24 months	1.20	1.20	1.25	1.41*	1.41*	1.44*
Nonsingleton		1.40*	1.50*		1.43*	1.59*
Mother's age > 35 years at child's birth		1.14	1.25		1.30	1.43
Mother's age ≤ 18 years at child's birth		1.19	1.30		1.34	1.56
Mother not married, 24 months		0.96	1.06		0.88	0.97
Labor complications			0.78			0.92
Obstetric procedures			1.12			1.10
Medical risk factors in pregnancy			1.01			1.15
Behavioral risk factors in pregnancy			1.04			1.05
Moderately low birth weight			0.95			0.84
Family member with mental illness			0.68			0.62
Family member with learning disability			1.61**			1.78***
Household has person with special needs			1.11			1.18
Maternal health problems, 9 months			1.02			1.26
Mother depressed, 9 months			1.45			1.14
Mother isolated, 9 months			0.77			0.80
Parenting score, 24 months			0.95			0.92
Child in child care center (not Head Start) > 10 hr/week, 48 months			0.34***			0.34***
Child in Head Start > 10 hr/week, 48 months			0.39***			0.40***
Approaches to learning problems, 24 months			1.52			1.06
Internalizing problems, 24 months			1 00			1.18
Externalizing problems, 24 months			0.78			0.86
Max-rescaled R^2	0.18	0.18	0.21	0.20	0.20	0.23
Tjur's R^2	0.13	0.13	0.15	0.14	0.15	0.17

Note. Child age and parenting scores are standardized with a mean of 0 and an *SD* of 1. SES = socioeconomic status.

[a]Sample size is rounded to the nearest 50 per Early Childhood Longitudinal Study, Birth Cohort confidentiality requirements.

*p < .05. **p < .01. ***p < .001. Weighted regressions.

in the range of 7:1 when comparing the lowest and highest SES quintiles. Other noteworthy findings included the positive effect on low reading of having a family member with a learning disability as well as the strong effects of child care more than 10 hr/week in decreasing the odds of low reading at kindergarten entry.

Low Math Performance

Table 5 includes the calculations for low math performance at 60 months; results generally are similar to those for low reading. The effect of being a late talker (2.20:1) was significantly and positively related to low math scores, as was low receptive vocabulary (3.51:1). The interaction between these variables was not significant. African American children were at increased odds for low math scores (1.52:1).

The effect of the lowest SES quintile was even larger than for low reading, with odds of almost 15 to 1 for the lowest SES quintile and almost 8 to 1 for the second-lowest quintile. In Model 3, quality parenting and 48-month center-based child care or Head Start for more than 10 hr/week resulted in decreased odds of low math performance. Having a family member with learning disabilities increased the odds by 1.65:1. These variables also partially accounted for the negative effect of low SES on the outcomes. The results using sample-wide cutoffs showed very similar patterns.

Problem Behavior

Table 6 shows calculations for the odds of teacher-reported behavior problems—approaches to learning and externalizing and internalizing problems—at 60 months. Model 2 for approaches to learning problems showed that, even after extensive controls, being a late talker significantly increased a child's odds (2.19:1) for difficulties in this area. In addition, in Model 1, low SES increased a child's odds of having approaches to learning problems,

Table 5. Odds ratios of low math performance at 60 months (n = 4,200[a]).

Variable	Gender-specific 10% cutoffs			Overall 10% cutoffs		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Late talker, 24 months	2.20**	2.17*	1.94*	2.06*	2.01*	1.80
Low receptive vocabulary, 48 months	3.51***	3.59***	2.62***	3.39***	4.48***	3.42***
Late talker, 24 months × low vocabulary, 48 months	0.99	0.97	1.15	0.91	0.89	0.97
African American	1.52*	1.53*	1.49	1.66*	1.75**	1.67*
Hispanic	0.91	0.94	0.79	1.03	1.07	0.92
Other race	1.12	1.12	0.94	1.31	1.33	1.18
Child age	0.62***	0.62***	0.60***	0.62***	0.62***	0.60***
Male	1.11	1.12	1.03	1.32	1.33	1.20
Lowest SES quintile	14.87***	16.33***	8.86***	11.91***	12.70***	7.89***
Second-lowest SES quintile	7.74***	8.18***	5.15***	6.90***	7.18***	5.05***
Middle SES quintile	6.14***	6.34***	4.87***	4.91***	4.94***	4.08***
Second-highest SES quintile	2.96**	3.03**	2.66*	2.36*	2.37*	2.14
Male × child age, 24 months	1.23	1.22	1.27	1.29	1.29	1.32
Nonsingleton		1.33	1.33		1.39	1.40
Mother's age > 35 years at child's birth		1.13	1.18		0.84	0.86
Mother's age ≤ 18 years at child's birth		0.74	0.81		0.84	0.97
Mother not married, 24 months		0.99	1.02		0.88	0.92
Labor complications			0.88			0.94
Obstetric procedures			1.10			1.04
Medical risk factors in pregnancy			1.09			1.10
Behavioral risk factors in pregnancy			0.92			0.83
Moderately low birth weight			1.05			1.09
Family member with mental illness			0.66			0.62*
Family member with learning disability			1.65*			1.80**
Household has person with special needs			1.42			1.17
Maternal health problems, 9 months			1.15			1.17
Mother depressed, 9 months			1.08			0.91
Mother isolated, 9 months			1.17			1.07
Parenting score, 24 months			0.80*			0.76*
Child in child care center (not Head Start) > 10 hr/week, 48 months			0.41***			0.46***
Child in Head Start > 10 hr/week, 48 months			0.44***			0.40***
Approaches to learning problems, 24 months			1.60			1.47
Internalizing problems, 24 months			0.96			0.91
Externalizing problems, 24 months			1.43			1.53
Max-rescaled R^2	0.25	0.25	0.29	0.25	0.26	0.29
Tjur's R^2	0.16	0.16	0.20	0.17	0.17	0.20

Note. Child age and parenting scores are standardized with a mean of 0 and an *SD* of 1. SES = socioeconomic status.

[a]Sample size is rounded to the nearest 50 per Early Childhood Longitudinal Study, Birth Cohort confidentiality requirements.

*p < .05. **p < .01. ***p < .001. Weighted regressions.

but this was largely explained by the control variables in Model 2. Higher quality parenting decreased the odds of approaches to learning problems at 60 months, and a child in Head Start for more than 10 hr/week increased the odds of approaches to learning problems at 60 months.

Even after extensive controls, the odds of having internalizing problems were increased by low vocabulary at 48 months (2.86:1). Being a late talker did not significantly affect these odds, although it exerted an indirect effect via its effect on 48-month vocabulary. Both late talker and low 48-month vocabulary significantly increased the odds of externalizing problems at 60 months. Low SES also increased the odds of externalizing problems—an effect largely explained by the control variables in Model 2. These findings were generally replicated using sample-wide cutoffs in Table 7, although the late talker and 48-month vocabulary lost significance there for externalizing problems.

Discussion

Our study had three purposes. First, we attempted to identify risk factors for being a late talker at 24 months. Second, we investigated whether late talkers continue to have low vocabulary at 48 months. Third, we examined whether being a late talker and/or having low 48-month vocabulary plays a unique role in children's school readiness. We designed the study to extend the current knowledge base by analyzing a population-based sample from the United States and by focusing on a large number of variables that have been implicated as risk factors in prior studies, including sociodemographics, pregnancy and birth characteristics, family health and well-being, parenting and child care, and early behavioral functioning. Use of a nationally representative sample and the inclusion of numerous potential risk factors permit us to clarify the relationship between these factors and late talker status and

Table 6. Odds ratios of teacher-reported behavior problems at 60 months (n = 3,000[a]) using gender-specific cutoffs.

Variable	Approaches to learning problems		Internalizing problems		Externalizing problems	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Late talker, 24 months	2.51**	2.19**	1.51	1.40	1.72*	1.78*
Low receptive vocabulary, 48 months	1.45	1.46	2.98***	2.86***	1.89*	2.05**
Late talker, 24 months × low vocabulary, 48 months	0.79	0.64	0.97	1.03	0.63	0.54
African American	1.25	0.88	0.59	0.57	1.62*	1.35
Hispanic	1.38	1.30	0.91	0.80	0.84	0.83
Other race	1.23	0.98	0.51	0.49	1.36	1.12
Child age	1.06	1.03	1.26	1.25	1.02	1.05
Male	0.96	0.91	1.10	1.09	1.06	1.05
Lowest SES quintile	3.67***	1.62	1.51	1.41	2.91***	1.59
Second-lowest SES quintile	3.10**	1.78	1.11	1.00	1.96*	1.31
Middle SES quintile	2.84**	1.95	1.49	1.41	1.81*	1.34
Second-highest SES quintile	1.54	1.27	1.10	1.11	1.10	0.93
Male × child age, 24 months	1.27	1.28	1.04	1.07	1.02	0.97
Nonsingleton		0.88		1.21		0.83
Mother's age > 35 years at child's birth		0.70		0.67		0.63
Mother's age ≤ 18 years at child's birth		0.60		1.07		0.86
Mother not married, 24 months		1.21		0.77		1.66*
Labor complications		1.10		1.33		1.25
Obstetric procedures		0.94		0.65		0.96
Medical risk factors in pregnancy		1.43		1.73*		1.59*
Behavioral risk factors in pregnancy		1.58		0.85		1.36
Moderately low birth weight		1.30		0.77		0.99
Family member with mental illness		1.28		1.16		1.18
Family member with learning disability		1.11		0.78		1.32
Household has person with special needs		1.18		0.88		1.42
Maternal health problems, 9 months		1.27		1.64		0.98
Mother depressed, 9 months		0.94		0.43		0.96
Mother isolated, 9 months		1.06		0.90		0.96
Parenting score, 24 months		0.64***		0.86		0.90
Child in child care center (not Head Start) > 10 hr/week, 48 months		1.37		0.64		1.34
Child in Head Start > 10 hr/week, 48 months		1.67*		0.89		1.19
Approaches to learning problems, 24 months		1.37		0.78		1.12
Internalizing problems, 24 months		0.75		1.72		0.39**
Externalizing problems, 24 months		1.30		0.92		1.71
Max-rescaled R^2	0.07	0.11	0.03	0.05	0.07	0.10
Tjur's R^2	0.03	0.06	0.02	0.03	0.04	0.06

Note. Child age and parenting scores are standardized with a mean of 0 and an *SD* of 1. SES = socioeconomic status.

[a]Sample size is rounded to the nearest 50 per Early Childhood Longitudinal Study, Birth Cohort confidentiality requirements.

*p < .05. **p < .01. ***p < .001. Weighted regressions.

enable us to control for possible confounding factors to determine whether late talking has a unique effect on children's school readiness in the U.S. population as a whole.

Risk Factors for Being a Late Talker

We found that a number of sociodemographic, birth, and family variables were significantly related to being a late talker at 24 months of age. As expected, boys were significantly more likely than girls to be a late talker. Removing this effect by using gender-specific norms, we found that low SES strongly increased the odds of being a late talker—an effect largely explained by low birth weight, the quality of parenting, time in day care, and the child's approaches to learning (attention) problems. The finding that boys are at greater risk than girls of being a late talker and in early language development is consistent with several population-based investigations that addressed this issue (Bleses & Vach, 2013; Dale et al., 2010; Reilly et al., 2007; Westerlund & Lagerberg, 2008) as well as other studies of early language development (e.g., Harrison & McLeod, 2010; Maatta et al., 2012).

Also, difficulties with approaches to learning at 24 months (i.e., having difficulties paying attention, working independently, concentrating, and completing tasks) were associated with late talker status. This result is consistent with that of Henrichs et al. (2013). Because ratings of children's behavior and the M-CDI were both completed when the children were 24 months of age, the direction of the relationship is unclear. It could be that having problems with approaches to learning is a risk factor for being a late talker, or it could be that this difficulty is the result of low language abilities at an early age. Whichever the direction of causality, and other things being equal, problems

Table 7. Odds ratios of teacher-reported behavior problems at 60 months (n = 3,000[a]) using overall cutoffs.

Variable	Approaches to learning problems		Internalizing problems		Externalizing problems	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Late talker, 24 months	2.27**	2.10**	1.06	1.01	1.52	1.56
Low receptive vocabulary, 48 months	1.84*	1.83*	3.64***	3.62***	1.32	1.39
Late talker, 24 months × low vocabulary, 48 months	0.90	0.85	1.11	1.06	0.57	0.52
African American	1.25	0.96	0.57	0.56	1.78**	1.41
Hispanic	1.13	1.05	0.85	0.76	1.10	1.10
Other race	1.24	1.04	0.52	0.49	1.88*	1.49
Child age	1.06	1.03	1.24	1.24	1.22	1.24
Male	1.91***	1.86***	1.01	1.02	4.33***	4.18***
Lowest SES quintile	4.53***	2.46*	1.55	1.48	2.95***	1.53
Second-lowest SES quintile	3.97***	2.71**	1.15	1.04	1.94*	1.21
Middle SES quintile	2.79**	2.09*	1.50	1.43	1.45	1.01
Second-highest SES quintile	1.93*	1.65	1.11	1.14	1.32	1.14
Male × child age, 24 months	1.28	1.29	1.06	1.09	0.94	0.91
Nonsingleton		0.74		1.25		1.07
Mother's age > 35 years at child's birth		0.56*		0.67		0.69
Mother's age ≤ 18 years at child's birth		0.87		1.07		1.05
Mother not married, 24 months		1.22		0.73		1.78
Labor complications		1.10		1.34		1.03
Obstetric procedures		1.05		0.64*		0.95
Medical risk factors in pregnancy		1.38		1.73*		2.08**
Behavioral risk factors in pregnancy		1.24		0.90		1.87*
Moderately low birth weight		1.23		0.77		0.73
Family member with mental illness		1.24		1.11		1.15
Family member with learning disability		1.32		0.76		1.10
Household has person with special needs		0.90		0.88		0.97
Maternal health problems, 9 months		1.10		1.67		0.64
Mother depressed, 9 months		1.18		0.44		1.02
Mother isolated, 9 months		0.97		0.92		1.00
Parenting score, 24 months		0.73***		0.86		0.83
Child in child care center (not Head Start) > 10 hr/week, 48 months		1.31		0.66		1.72**
Child in Head Start > 10 hr/week, 48 months		1.45		0.90		1.36
Approaches to learning problems, 24 months		1.25		0.68		1.63
Internalizing problems, 24 months		0.79		1.67		0.37**
Externalizing problems, 24 months		1.20		1.06		1.51
Max-rescaled R^2	0.11	0.14	0.03	0.05	0.12	0.16
Tjur's R^2	0.07	0.09	0.02	0.03	0.06	0.09

Note. Child age and parenting scores are standardized with a mean of 0 and an *SD* of 1. SES = socioeconomic status.

[a]Sample size is rounded to the nearest 50 per Early Childhood Longitudinal Study, Birth Cohort confidentiality requirements.

*p < .05. **p < .01. ***p < .001. Weighted regressions.

with approaches to learning are positively associated with being a late talker. As noted earlier, co-occurrence of attentional difficulties and SLI have been observed, but the nature of the relationship remains unclear (Redmond, 2016).

Of note is that the strong relation between SES and being a late talker was fully explained by the mediating variables. The effect of SES on late talking was inconsistent in the four prior population-based studies that were reviewed. Our study helps clarify the relationship because the investigation targeted a large number of possible explanatory variables in the statistical analyses. We found that the effects of SES were accounted for by a number of variables, including quality parenting and children's attendance in a day care center. These findings are consistent with a large number of studies that have found that quality parenting supports children's development and that the shared environment of parents and children influences children's language development (Dale et al., 2015). Warm and nurturing parents create stimulating environments and provide supports by establishing routines. This, in turn, results in higher cognitive and language abilities (cf. Conger & Donnellan, 2007; Guo & Harris, 2000; Yeung et al., 2002). Also, these results are supported by past studies that have shown that center-based child care promotes children's outcomes in many areas and that child care appears to minimize the effects of stress experienced by low-income parents (Hall et al., 2009; NICHD Early Child Care Research Network, 2000, 2002, 2003; Melhuish et al., 2008; Vallotton et al., 2012; Vandell et al., 2010). However, attendance in child care has also been found to increase children's risk for behavior problems (NICHD Early Child Care Research Network, 2003).

Vocabulary Status at 48 Months

We also investigated whether children who were late talkers at 24 months continue to have low vocabulary scores at 48 months. We found that one fourth of later talkers continued to have low vocabulary scores (defined as the lowest 10%) during preschool. This is consistent with previous studies that have shown that not all late talkers continue to have low language abilities (Dale & Hayiou-Thomas, 2013; Rescorla, 2009; Rice et al., 2008). However, we also found that even after entering a large number of controls, being a late talker at 24 months of age had a significant effect on later vocabulary. Late talkers were three times more likely to have low vocabulary scores at 48 months. It should be pointed out, however, that SES had the largest effect on children's vocabulary scores even after controlling for a large number of variables, including parenting quality and center-based child care and/or Head Start services. As suggested by Rescorla and Dale (2013), SES may not show a direct effect on late talking once other variables are controlled, but its association with the child's language performance increases as children progress through the preschool years and enter kindergarten.

Role of Late Talking in School Readiness at 60 Months

Our study also investigated whether late talking played a unique role in children's school readiness at 60 months of age, a question that has received relatively little attention. We found that late talking increased the odds of low reading scores, low math scores, and both approaches to learning and externalizing behavior problems. Overall, these findings show that being a late talker places children at risk for reduced school readiness and are supported by existing research that has demonstrated the important relationships between children's language abilities and their reading, math, and behavioral functioning (e.g., Braze et al., 2007; Cole et al., 2010; Purpura et al., 2011; Redmond, 2016; Verhoeven & Van Leeuwe, 2008).

It should be noted that low vocabulary at 48 months played a larger role in children's school readiness than late talker status. Having a low vocabulary prior to school entry, independent of late talker status at 24 months, more than tripled the odds of low reading in kindergarten and math scores in kindergarten. This finding illustrates the critical importance of vocabulary in school readiness. In particular, being a late talker at 24 months is itself a strong predictor of low vocabulary at 48 months.

However, the most significant finding is the very large effect that SES had on children's school readiness, even after controlling for a large number of variables. Children from families in the lowest SES quintile were about seven times more likely to have low reading scores, nearly 15 times more likely to have low math scores, almost four times more likely to have difficulties with approaches to learning, and almost three times more likely to have externalizing problems compared with children in the highest SES quintile. Even children in the middle-SES and second highest quintiles were at increased risk for these outcomes. These important findings demonstrate that the effects of SES are profound and increasing as children age from birth to school entry (Hillemeier, Farkas, Morgan, Martin, & Maczuga, 2009; Rescorla, 2013).

Limitations

There are at least three limitations to this study. The first is that direct observations of the children's vocabulary at 24 months were not made. Instead, an abbreviated version of the M-CDI, a parent report measure, was used. However, the M-CDI and its short form have been used extensively in research and clinically (cf. Bleses & Vach, 2013; Moyle, Ellis Weismer, Lindstrom, & Evans, 2007; Thal, Miller, Carlson, & Vega, 2005). Through its usage, parents have been found to be reliable reporters of young children's vocabulary. Further, any measurement error in our vocabulary measure simply indicates that our results are conservative; a more reliable measure would have produced even larger associations. Second, children's receptive and expressive vocabularies were not both measured at each of the data collection waves. However, strong correlations between children's receptive and expressive vocabularies have been reported in the literature. For example, Sideridis and Simos (2010) found a significant correlation of .66 between receptive and expressive vocabularies. In addition, Tomblin and Zhang (2006) did not find evidence for a receptive–expressive dichotomy and argued that separate measures of these variables are not warranted. Third, in light of the large size of the sample, the ECLS-B did not conduct specific observations of parent–child and caregiver–child interactions in homes and child care centers. Thus, we are unable to discuss the quantity and quality of language that the children experienced in these two settings. Such studies are desirable because they would help us better understand the language development of children from a wide variety of backgrounds and cultures.

Implications

This study has several key implications. First, the study demonstrates the high value of using publically available population-based data sets to address key questions. Such data sets permit researchers to investigate questions that they could never answer on their own. This is because individual researchers and single research groups do not have access to resources that allow them to recruit a large representative sample and gather data on a large number of independent and dependent variables (Justice, Breit-Smith, & Rogers, 2010). Examples of existing data sets include but are not limited to the ECLS-B (which was used in this study), the Early Children Longitudinal Study–Kindergarten Cohort, the NICHD Study of Early Child Care/NICHD Study of Early Child Care and Youth Development, Head Start Family and Child Experiences Study, and the National Household Education Survey. In addition, a number of

data sets are available from the National Center for Education Statistics (http://nces.ed.gov/pubsearch/licenses.asp). Through these data sets, which are underutilized in the field of speech-language pathology, researchers can answer pressing questions and obtain findings that are generalizable to the population level.

Second, our investigation demonstrates the critical importance of children's vocabulary abilities at both 24 and 48 months of age for their later development. Thus, it is essential that children with low vocabulary levels at any point in their development be provided with interventions that promote vocabulary learning. It is well documented that children with strong vocabularies are able to take advantage of their vocabulary knowledge to acquire new words and that the gap between children with weak and strong vocabularies widens over time. Also, children with strong vocabularies can use them to decode and comprehend written texts, which is crucial for the development of reading skills (Braze et al., 2007; NICHD Early Child Care Research Network, 2005). Vocabulary support provided early in life would greatly enhance children's later vocabulary development as well as their school readiness.

Third, our study identified three potentially malleable factors that are related to being a late talker: parenting quality, child care, and approaches to learning. Regardless of SES, it appears that there are parents who could use additional supports during their children's early years in order to foster their children's development. Thus, efforts should be made to help parents engage in high-quality interactions with their children in order to foster language development and create homes with more cognitively stimulating environments. Of course, it is essential that these supports be culturally sensitive. In addition, it appears that attendance in child care for 10 hr or more/week enhances children's vocabulary. Therefore, providing high-quality child care to low-income parents would likely benefit the vocabulary development of their children. Fully funding early development programs so that they can serve all low-income families who need it is one mechanism for moving closer to this goal. Such programs include Early Head Start and the Nurse-Family Partnership, a preventive intervention that has been shown to effectively improve children's language and emotional development (Olds, 2006).

Last, our findings highlight the need for speech-language pathologists and the state and national organizations that represent them to be involved at the policy level to help develop and implement public health and educational programs that maximize children's language development. For example, in a number of communities across the United States, city- and county-wide programs are being enacted to address the "word gap" and promote children's vocabulary and language development. One such program is Providence Talks, a free program offered to families with young children living in Providence, Rhode Island (http://www.providencetalks.org). Through this program, families are provided with an LENA (Language Environment Analysis) device that monitors the amount of talk children hear and receive biweekly coaching to increase the amount of talk that children hear in order foster vocabulary and language growth. This program and others like it are excellent examples of public health programs in which speech-language pathologists should be involved from creation through implementation and evaluation.

Likewise, efforts are occurring throughout the country to increase the number of Early Head Start programs, which work closely with parents, and to offer universal preschool. The Every Student Succeed Act, passed in December 2015, has expanded the previous national education law by calling for the provision of high-quality preschool across the nation. Given the critical importance of early vocabulary and language, it is imperative that speech-language pathologists be involved at the policy level. No other profession has the expertise and training in language development and language facilitation strategies that speech-language pathologists do. Speech-language pathologists have much to offer in addition to the remediation of existing language disorders and must assume a more active role in the prevention of language delays and disorders and in shaping public health and educational policies and programming at the local, state, and federal levels.

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