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Preschool language development among children of adolescent mothers

Monica Oxford[a,*] and **Susan Spieker**[b]
a *School of Social Work, University of Washington, 1107 NE 45th Street, Seattle, WA, 98105, United States*
b *Child and Family Nursing, University of Washington, United States*

Abstract

This longitudinal study examined a comprehensive set of predictors of preschool language performance in a sample of children of adolescent mothers. Six domains of risk (low maternal verbal ability, intergenerational risk, contextual risk, relational risk, home environmental risk, and child characteristics) for poor preschool language development, measured throughout early childhood, were examined in a sample of 154 children born to adolescent mothers. Logistic regression revealed that having a poor language-learning home environment was associated with children's low language scores even after accounting for mothers' below-average verbal ability. More importantly, however, was the exploration of the 'dual risk' hypothesis that evaluated the effects of combined risk factors. Being reared by a mother with low verbal ability amplified the risk of a poor quality home linguistic environment, whereas having a poor home linguistic environment did not adversely affect the language development of children with mothers of average verbal ability. Implications for intervention are discussed with regard to specificity of intervention efforts within subpopulations of risk identified in this paper.

Keywords

Preschool language; Adolescent mothers; Risk factors; Home environment; Latent profile analysis

1. Introduction: Early language and emerging literacy

Emerging literacy consists of those practices, attitudes, and skills that are precursors to literacy and are developed early in life before formal instruction or school entry (Morrow, 2001; Whitehurst & Lonigan, 1998). Emergent literacy activities include language, pretend reading and writing, alphabet knowledge, and emerging decoding (Morrow, 2001; Senechal & LeFevre, 2001). One of the indicators of emerging literacy that has an enduring relationship with later academic and cognitive attainment is a child's language development during the preschool years. La Paro and Pianta (2000) found a moderate effect size (.49) across more than 60 studies predicting academic achievement from kindergarten through second grade from early cognitive skills including preschool language development. Similarly, others have found that early language performance is an important predictor of later reading, spelling and language, independent of socioeconomic status, and such predictions remain stable during early elementary school years (Walker, Greenwood, Hart, & Carta, 1994). Recently, in a large normative sample, the NICHD Early Child Research Network (2005) demonstrated that preschool oral language operated both directly and indirectly on first and third grade outcomes. Specifically, scores on the 54 month Preschool Language Scale (PLS; Zimmerman, Steiner,

* Corresponding author. *E-mail address:*mloxford@u.washington.edu (M. Oxford)..

& Pond, 1992) predicted third grade reading directly and indirectly through its positive effect on first grade word recognition, decoding, and vocabulary assessments. Moreover, they found that oral language skills at 36 months had a large impact on broad language and early code based skills at 54 months of age. In a theoretically driven study of early literacy, Snow, Tabors, Nicholson, and Kurland (1995) concluded that oral language skills provided more information about the potential for children's academic success than other skill sets including knowledge of letters, shapes, colors, and numbers or print.

1.1. Children of adolescent mothers

Given the increasing importance of emergent literacy and its development before formal school entry, the present study focused on the processes that lead to poor language development among preschool-aged children of adolescent mothers. For more than 30 years, researchers have reported that the children of adolescent mothers do more poorly on cognitive tests and measures of school achievement compared to children of older mothers (Baldwin & Cain, 1980; Broman, 1981; Hardy, Welcher, Stanley, & Dallas, 1978; Kellam, Ensminger, & Turner, 1977; Wadsworth, Taylor, Osborn, & Butler, 1984). The effects are especially persistent for tests of verbal ability and vocabulary (Wadsworth et al., 1984). Children born to adolescent mothers are at elevated risk for lower cognitive and verbal attainment (Dubow & Luster, 1990; Moore & Snyder, 1991), and school failure and grade retention (Furstenberg, Brooks-Gunn, & Morgan, 1987). Brooks-Gunn (1990) noted in the Baltimore study of adolescent mothers (a predominately African American low-income sample) that 59% of children repeated a grade by the time they reached adolescence. Several studies have shown the average scores of children of adolescent mothers tend to be one standard deviation below the mean on standardized measures of vocabulary, such as the Peabody Picture Vocabulary Test (PPVT; Dunn & Dunn, 1981) and oral language skills, such as the PLS (Dubow & Luster, 1990; Luster & Vandenbelt, 1999). Clearly, children of adolescent mothers are at risk for difficulty in early elementary school, as a group, because their language performance is at the lower end of the distribution. An understanding of the processes that lead to such variation and identifying the appropriate explanatory models for those at greatest risk for poor language performance and potentially long-term academic difficulty is of great importance for the success of prevention and intervention efforts (Whitehurst & Lonigan, 1998). In particular, it is of practical and applied importance to determine, within a comprehensive model, whether potential intervention targets, i.e., those factors that are *malleable* such as parenting practices, predict poor outcomes across diverse samples when considered in context with other less malleable risk factors. If potential intervention targets are not predictive when other potent explanatory factors are also considered, then interventions focused on them may not be effective in an applied setting. This study examined the most prominent risk factors related to poor language development in combination with factors that may be more specific to populations of adolescent mothers.

1.2. Risk factors associated with poor preschool language development in adolescent and low income samples

Although children of adolescent mothers are at greater risk for poorer cognitive and academic outcomes, not all children of adolescent mothers show difficulty in this area (Dubow & Luster, 1990). Significant within-group variation suggests that adolescent parenthood, by itself, is not the main factor in explaining variation in language performance. Adolescent mothers, like many other high-risk groups, are not randomly distributed in the population; rather their early parenthood is associated with their increased likelihood of exposure to various demographic risk factors such as poverty, low maternal education, single parent families, and large family size (Coley & Chase-Lansdale, 1998; Hoffman, 1998; Moore, Morrison, & Greene, 1997). Similar risk factors are also salient to language development in the general population, specifically, poverty and low maternal education (Dollaghan et al., 1999; Morisset, Barnard,

& Booth, 1995; Thomasgard & Shonkoff, 1993; Walker et al., 1994). Much of the impact of young motherhood on the child is mediated by multiple factors associated with socioeconomic status (Kinard & Klerman, 1983), especially maternal education (Kinard & Reinherz, 1984) and mothers' cognitive achievement (Moore & Snyder, 1991).

One of the more pervasive factors relevant for lower cognitive attainment and language is lower socioeconomic status. Several studies have demonstrated that children raised in economically disadvantaged families have lower levels of cognitive functioning, verbal ability, and academic achievement compared to children of more affluent families (Bradley & Whiteside-Mansell, 1997; Duncan, Brooks-Gunn, & Klebanov, 1994). Comparisons of child outcomes, between younger and older mothers, that include measures of socioeconomic status support the primacy of socioeconomic status. Wadsworth et al. (1984) found that although maternal age was a significant predictor of child vocabulary at age 5, several other variables, including socioeconomic status, were stronger predictors of verbal ability. Furstenberg et al. (1987) found that their Boston sample of African American children of adolescent mothers had similar scores on a preschool language inventory as other urban African American preschoolers, but lower scores than children of middle class African Americans and European Americans. Maternal education, another robust measure of socioeconomic status, is predictive of child language development (Guo & Harris, 2000). Both in general populations (Dollaghan et al., 1999) and high-risk populations (Luster & McAdoo, 1996), lower maternal education predicted poorer early language performance and academic achievement. Similarly, in a sample of adolescent mothers, Dubow and Luster (1990) found maternal education predicted child academic scores.

Other explanatory factors relevant to language performance have also been found to differ between younger and older mothers, as well as between lower and higher socioeconomic groups. Parenting practices that are conducive to language development include maternal responsiveness (Tamis-LeMonda, Bornstein, & Baumwell, 2001), nondirective parenting style (Murray & Hornbaker, 1997), stimulating home environments (Morisset et al., 1995), stimulating maternal speech (Hart & Risley, 1995; Hoff-Ginsberg, 1990), and maternal verbal responsiveness (Baumwell, Tamis-LeMonda, & Bornstein, 1997). Many of these practices vary by age of mother (Barratt & Roach, 1995; Keown, Woodward, & Field, 2001) and by socioeconomic class (Dollaghan et al., 1999; Hart & Risley, 1995). Moore et al. (1997) reported that children of adolescent mothers are exposed to significantly lower quality parenting practices as indicated by subscales of the Home Observation for Measurement of the Environment (HOME; Caldwell & Bradley, 1984) that measure cognitive stimulation and emotional support. Keown et al. (2001) found that adolescent mothers provided less verbal stimulation and were not as sensitive or affectionate with their children compared to older mothers, but when background factors including child characteristics, parenting behaviors, and the HOME environment were included in the model examining child's language ability, maternal age at birth was no longer significant.

In addition to parenting practices, quality of the parent–child relationship is associated with language outcomes. A meta-analysis of the association between attachment security and later language reported an effect size of $r = .28$ (van IJzendoorn, Dijkstra, & Bus, 1995), suggesting that language development is promoted within the context of a secure relationship between caregiver and child. Hann, Osofsky, and Culp (1996) demonstrated, in a sample of adolescent mothers, that indicators of mother and child interaction were strong predictors of 44-month language performance even after controlling for demographic risk. Luster and Vandenbelt (1999) reported that parent–child interactions, as assessed by multiple methods including videotaped assessment of Nursing Child Assessment Teaching Scale (NCATS; Barnard, 1979) and assessments by project staff who provided services to mothers and their children, were significantly associated with language skills at 30 months of age for children of low-income adolescent mothers.

Another potential explanatory factor predicting child language performance includes mother's own cognitive or language ability. Luster and McAdoo (1994) proposed that low maternal cognitive attainment could influence children's cognitive skills both directly, through inherited potential, or indirectly, via maternal provision of less support for cognitive growth and development as compared to households with greater maternal cognitive resources. In their sample of African American children, Luster and McAdoo (1994) found both maternal IQ and HOME environment to be related to child language scores (PPVT) and other measures of reading and math performance, while maternal age at first birth and poverty status were not significant. Similarly, Guo and Harris (2000) simultaneously modeled maternal cognitive ability, cognitive stimulation in the home, parenting style, and demographic factors already noted. They found that the effects of poverty on cognitive development (including language) were completely mediated by home stimulation and parenting, while maternal cognitive function retained a strong direct effect on child cognitive development when home stimulation and parenting were controlled. Culp, Hubbs-Tait, Culp, and Starost (2001) found that maternal warmth predicted child PPVT scores even after taking into account maternal vocabulary and child sex, although other demographic controls were not included. Overall, few studies of child language and cognitive performance have examined maternal cognitive ability simultaneously with other potential risk factors (Luster & McAdoo, 1994), and none of the studies cited examined such comprehensive models within samples of adolescent mothers. Similarly, these studies did not assess whether the effect of home stimulation and parenting varied as a function of low maternal cognitive or language ability. The importance of assessing adolescent mothers' cognitive ability with other risk factors is directly related to the applied issue of targeting intervention efforts. If maternal cognitive ability moderates parenting practices then it would be necessary to assess the potential of intervention efforts to generalize to different subgroups of mothers based on cognitive functioning.

Children of adolescent mothers are also at risk because their parents are more likely to have some levels of accumulated risk from their own family backgrounds such as poverty and lower levels of educational achievement (Brooks-Gunn, 1990). Thus, it is necessary to assess the relevance of intergenerational risk to the language development of children of adolescent mothers. Luster, Bates, Fitzgerald, Vandenbelt, and Key (2000) found that the education level of the offspring's maternal grandmother was related to performance in language development at 54 months of age. Similarly, Chase-Lansdale, Brooks-Gunn, and Paikoff (1992) identified that adolescent mothers who were most successful in navigating parenthood were those adolescents whose mothers had higher levels of education and were less likely to depend on public assistance, suggesting that the resources of the family of origin were important to the success of young mothers' transition to adulthood.

Finally, adolescent mothers are also more likely than older mothers from the same backgrounds to have a history of aggressive and delinquent behaviors (Miller-Johnson et al., 1999; Woodward, Fergusson, & Horwood, 2001) and are more likely to have had mental health problems (Deal & Holt, 1998; Horwitz, Klerman, Kuo, & Jekel, 1991) or exposure to childhood maltreatment (Boyer & Fine, 1992; Smith, 1996). Adolescents are still maturing themselves, and some aspects of adolescent brain maturation and cognitive development appear to be independent of pubertal processes and continue long after puberty is over (Dahl, 2004). Adolescent mothers, like their non-parenting counterparts, are coping with the challenges associated with adolescence including impulse control, egocentrism, individuation and separation, and the development of self-reflective awareness (Shapiro, 2003). Shapiro (2003) noted that adolescent mothers, who are developmentally more egocentric and concrete in their functioning, have greater difficulty than adult mothers in empathic and contingent responses. Disentangling the effect of risk *within this population* and understanding both the variation in language outcomes and the process of risk are therefore very important.

1.3. Study objectives

Given this review, an appropriate model for predicting preschool language includes measures of both home linguistic environment and contextual risk, factors found to be relevant to language development for children of both the general population and the teen parent population.

However, the outcomes for children of adolescent mothers should also be assessed with regard to the potential for intergenerational risk given the characteristics of this population. Moreover, the model needs to include a measure of maternal language or cognitive ability to account for variation due to potentially shared genetic influences of language ability (Hoffman, 2003; Shonkoff & Phillips, 2000) that are *unmediated* by a cognitively stimulating home environment (Guo & Harris, 2000). Although this study was not designed to test a specific genetic transmission hypothesis, we agree with Shonkoff and Phillips (2000) who conclude, "… it is important to remember that a heritability estimate describes influences on individual differences in a characteristic. Environmental influences can have a profound effect on that characteristic, however, even when heritability is high" (p. 45). Similarly, Neisser et al. (1996) concluded that inherited traits are not *unchangeable*; rather, heritability can be changed by altering the environment. Thus, the influence of maternal cognitive abilities may persist after accounting for the influence of environment, as Guo and Harris have found, but the strength of this persistence can be altered by changing the environment. Environmental conditions can either exaggerate or compliment inherited characteristics (Shonkoff & Phillips, 2000); thus, it is necessary to examine the influence of the environment within the context of *potentially* inherited characteristics or abilities so that those environmental influences can be identified as potential intervention targets. Consequently, the objective of the present study was to examine a comprehensive risk model to predict impaired language attainment during preschool for children of adolescent mothers, a population of children known to experience poor language development, grade retention, and underachievement in school. The study framework was structured specifically to examine potential intervention targets in the context of low maternal verbal ability.

1.4. Study framework

Given the increased risk children of adolescent mothers face in their transition to formal schooling, it is necessary to consider the impact of various risk factors within this subpopulation while translating the findings into potential malleable intervention targets. With specific attention to the future use of these findings in the field of intervention, we have cast this study within the framework of risk factor research and cumulative risk literatures (see, for example, Burchinal, Roberts, Hooper, & Zeisel, 2000; Kazdin, Kraemer, Kessler, Kupfer, & Offord, 1997; Sameroff, 2000). The most "critical feature" from risk factor research is that risk is related to outcomes in a probabilistic rather than deterministic model (Kazdin et al., 1997; Sameroff, 2000). Risk factor research differs from causal models of research. Causal models suggest that if the cause is present the outcome will follow. Such models are deterministic (Kazdin et al., 1997). Risk factor research, in contrast, is based on the probability of an outcome given particular indicators. Sameroff (2000) argues that risk factor research has a unique place within applied settings because findings are easily translated into sets of indicators that are used to identify targets for interventions, much in the same way epidemiological research has identified and created intervention targets for the risk factors of heart disease.

In the same way, we pursued the identification of those risk factors that increase the likelihood of a child being at least one standard deviation below the mean on their language performance prior to school entry because early language performance is one of the better predictors of early school performance. Thus, we were interested *only* in identifying those children at greatest risk of school problems and those that would benefit the most from additional services and supports.

Moreover, we assessed whether potential intervention targets remain predictive in the presence of a more enduring risk factor, maternal language ability, and if effects are moderated by maternal language ability.

2. Method

2.1. Data analytic plan

Our analytical approach entails the use of cut-off scores that categorize individuals into specific groups such as high and low risk based on either empirical methods or distributions of data in the general population, as is typically found in cumulative risk research. We used logistic regression models to identify the likelihood of below normal range of language ability of preschool children of adolescent mothers given a set of potential risk factors.

First, we examined the effects of key influences identified in the literature (maternal verbal ability, intergenerational, contextual, home linguistic environmental, relational, and child characteristics) on child language development. Second, we tested a moderation hypothesis proposing that cognitively stimulating parenting practices would be more important for those children whose mothers' language performance was below average. We expected that a high-risk home linguistic environment would be more problematic for children whose mothers have below average performance on their own language than it would be for children whose mothers are average in their own language performance. If parenting practices retain their importance to language outcomes of offspring of low language performing adolescent mothers, then malleable intervention targets that enhance school readiness and language performance will have been successfully identified for an important high-risk subpopulation of adolescent mothers. If parenting practices do not retain their importance in increased likelihood of poor language performance then the search for other malleable intervention targets is warranted. We hypothesized a “dual risk” model where low language performing mothers provide an overall less stimulating home linguistic environment and their children are differentially vulnerable to its effects on their language performance.

Finally, in order to demonstrate the generalizability of the findings of current study, we sought confirmation of many previous reports, i.e., that mothers with cognitive deficits, as a group, tend to provide less stimulating environments (for review, see Kelly, Morisset, Barnard, & Patterson, 1996). We expected children whose mothers have low verbal ability to have increased risk for low language performance because of the potential risk from genetic contribution and the expectation that mothers with low verbal ability will provide a less cognitively stimulating home environment.

2.2. Sample and procedures

This study consisted of data from an ongoing natural history study examining the development of adolescent mothers and their children. Adolescents who were pregnant, unmarried, under age 18 and planning to carry their babies to term were recruited during 1992–1993 from urban prenatal clinics, alternative programs in the public schools, social service agencies, and through advertising. A total of 255 pregnant adolescents were enrolled in the study and completed the initial interview between June 1992 and September 1993. Based on national statistics for the race and ethnicity of unmarried adolescents giving birth during the same period from 1992 to 1993 (Ventura, Martin, Taffel, Mathews, & Clarke, 1994; Ventura, Martin, Taffel, Mathews, & Clarke, 1995), the study sample had a comparable percentage of European Americans (56% nationally versus 59% this sample), fewer African Americans (41% versus 22%), and more in other racial categories (3% versus 19%) such as biracial, Asian/Pacific Islanders, and Native Americans. The study sample closely reflected the ethnic/racial distribution for adolescents who gave birth in the local study area during 1992–1993 (Seattle-King County Department of

Public Health, 1998). Parent or guardian consent was obtained for participants who were not emancipated minors. Respondents were interviewed during pregnancy, every 6 months postpartum through age 3, and again at 54 months (4.5 years postpartum). Maternal interviews were approximately 2 h, typically took place in the respondents' home, and were conducted by trained professional staff. Depending on the assessment occasion, respondents received US $25–35 for completing the interviews. Mothers and their children were also brought to the University of Washington for two videotaped laboratory visits at 12 and 54 months postpartum. Mother and child were involved in a videotaped assessment of the Strange Situation to measure mother–child attachment at 12 months, and additional child language assessments and the maternal interview were conducted at the laboratory at 54 months.

The original sample consisted of 255 pregnant adolescents who enrolled in the study and completed the initial interview. The mean age was 16.5 years (*SD* = 1.0), and the sample had completed, on average, 9.2 years (*SD* = 1.3) of schooling. For 71% of the sample, this was their first pregnancy. Attrition over the first five waves of data collection was minimal, with interview completion rates typically above 95%. However, due to changes in funding, at 54 months postpartum, a subsample (*N* = 204) was selected for additional follow-up interviews; criteria for selection were completion of the laboratory procedures at 12 months or child assessments at 36 months. The analysis sample included 154 cases of the 204 that were also measured on the outcome, preschool language skills at 54 months of age. The majority of missing data were cases that were not followed (51 cases or 20%) or were missing the PLS score at 54 months of age (47 cases or 18%). We also deleted 3 cases that were missing more than 50% of their data, totaling 101 missing respondents. A comparison of the sample included in this analysis (*n* = 154) and those cases from the original sample (*N* = 255) did not differ with regard to maternal age (*p* = .13), maternal receipt of public assistance during pregnancy (*p* = .83), prior maternal pregnancy (*p* = .10), number of years of school completed (*p* = .67), primary means of financial support during pregnancy (*p* = .16), or child's sex (*p* = .65) and race (*p* = .85). Participants in this study were not from the same sample reported in Oxford et al. (2003), but were from the same sample reported in Keller, Spieker and Gilchrist (2005).

The infants were healthy at birth. Only 3 of the 154 infants in this sample weighed less than 5.5 pounds (range 4.7–5.3 pounds) and only 5 infants were in the hospital more than a week after birth (maximum 2 weeks). Three children were reported by their mothers to have developmental delays. One child with Down syndrome did not have PLS data and was excluded from these analyses; the two other children had development delays and were receiving services. One of these children had delays so severe that he could not be tested at 54 months; the other child was tested and is included in the data set. Intervention status of the children at 54 months was not obtained.

2.3. Measures

The study is part of an ongoing longitudinal study. For the purpose of this study, assessments and interviews conducted at pregnancy, and at 6, 12, 18, 24, 30, 36 and 54 months postpartum were used in the analyses.

2.3.1. Outcome: Child's preschool language performance—The Preschool Language Scale-3 (PLS-3; Zimmerman et al., 1992) was administered at 54 months to assess children's expressive and receptive language skills. It has been shown to be positively correlated with a variety of other emerging literacy measures including narrative production, comprehension, and a score of five subtests from the emergent literacy measures of the Early Childhood Diagnostic Instrument, which includes print and story concepts, letter naming, word sound awareness and writing (Snow et al., 1995). The PLS-3, which examines a wide variety of developmentally appropriate cognitive-linguistic skills, has been utilized extensively in both research and clinical settings. The reliability coefficient for preschool aged children on the PLS-3 scale is .92, with a high inter-rater reliability (89% agreement rate) and a between score correlation of .98 (Zimmerman et al., 1992). It provides a standard score, with a mean of 100 and standard deviation of 15; for this study we used the combined (receptive and expressive) standard score. Child's language performance was dichotomously coded as the dependent variable in a logistic regression analysis because we were interested in identifying processes most important in distinguishing those children at greatest risk for future problems in literacy and academic success. PLS scores were dichotomized such that a score of 1 represented those performing 1 standard deviation below the mean (≤ 85), a score of 0 represented average to above average performance (> 85). Descriptive data on all of the study variables are presented in Table 1 for the full sample and by child's language ability (low performing and average performing).

2.3.2. Predictors

2.3.2.1. Maternal verbal ability: Maternal verbal receptive ability, assessed at 2 years postpartum, was measured with the Peabody Picture Vocabulary Test Revised (PPVT; Dunn & Dunn, 1981). The PPVT demonstrates good construct validity; it is highly correlated with other vocabulary assessments and moderately correlated with intelligence, mathematics, reading, and language arts assessments; the split-half reliability coefficients for this age group range from .78 to .88 with test–retest (with alternate forms) reliability of standard score equivalents at .79 (Dunn & Dunn, 1981). For these analyses, we recoded the standard score (a normative population has a mean of 100 and *SD* = 15) to reflect below average maternal vocabulary. The PPVT score was dichotomized such that a score of 1 (≤85) represented those performing 1 standard deviation below the mean, a score of 0 (> 85) represented average performance; almost half (46%) of the sample was at least one standard deviation below the standardized PPVT mean.

2.3.2.2. Intergenerational risk: At the first interview, when the respondents were pregnant, they responded to two retrospective questions regarding their mother's education and their family's use of public assistance. Grandparent welfare was a single question that asked if the respondents' parents/guardians received welfare in the past year (yes = 1, no = 0); 41% of the sample received welfare in the past year. Maternal grandparent education was the respondents' report, recoded to reflect high school graduate (yes = 0, no = 1); 22% of grandmothers did not have a high school education.

2.3.2.3. Maternal contextual risk: Three indicators were used to assess contextual risk: maternal age, extended dependence on public assistance, and maternal education. *Maternal age* at pregnancy was the respondent's age at the first interview, recoded to represent young age of mother: 1 (16 years or younger), or 0 (17 and older). *Public assistance* was a cumulative index of the respondent's reports that public assistance was her main source of income at six time points (6, 12, 18, 24, 30 and 36 months postpartum), recoded such that a score of 1 indicated that the respondent was dependent on public assistance for 3 or more of the six occasions, and a score of 0 indicated respondent reported being dependent on welfare on 2 or fewer occasions; 55% of the sample had cumulative dependence on welfare. *Maternal* education was measured at 54 months postpartum rather than at an earlier time point because there is evidence that adolescent mothers continue their education long after the birth of their child (Whitman, Borkowski, Keogh, & Weed, 2001). Maternal education was coded into a categorical variable: 0 = no high school or GED (30%); 1 = high school graduate or GED (55%); and 2 = some college or vocational training (15%). A three-category variable was selected to contrast both high school education and less than a high school education with some college or vocational education.

2.3.2.4. Home environmental risk: The goal of this analysis was to create two categories of mothers, those who have characteristics that represent low levels of linguistic resources for their children (scores on eight indicators) and those that represent high levels of linguistic resources. The eight indicators were used in a latent profile analysis, which are discussed in detail in Results. All eight indicators were measured between 12 and 30 months of age. Two indicators at three time points were from the Nursing Child Assessment Teaching Scale (NCATS; Barnard, 1979) and one measure at two time points was from the Home Observation for Measurement of the Environment (HOME; Caldwell & Bradley, 1984). Mother–child dyads were observed in a teaching scenario at 12, 18, and 30 months using the NCATS from which two indicators, maternal warmth and cognitive stimulation, were developed at each time point. Maternal warmth was the sum of a subset of six observed items of the NCATS that measure praise, affection, and encouragement. Sample items included caregiver laughs/smiles at child, caregiver praises child's success, and caregiver gently touches/kisses/ hugs child. Cognitive stimulation was a subscale defined in the NCATS (17 items) as fostering cognitive growth. The subscale included items such as: caregiver provides a distraction-free environment, caregiver allows child to perform task at least once before intruding, caregiver responds to child's vocalizations, and caregiver uses explanatory verbal style more than imperative style. Items for each index were summed at each age. The HOME observational measure was administered at 12 and 24 months postpartum and consisted of 45 dichotomously scored items. Ten HOME items identified in a previous study of this sample were used to measure the cognitive-linguistic environment (Hill, 2000). Items included maternal verbal responding, teaching style, child gets out of house, mother provides toys during interview, mother provides age appropriate learning equipment and toys, mother talks to child, mother encourages developmental advance, mother reads to child, and child has three books of his/ her own. Items for the index at each age were summed. These two HOME indicators and the two NCATS indicators at three ages resulted in eight indicators of the maternal linguistic environment provided to the child, which were subjected to a latent profile analysis. Taken together, these indicators had a Cronbach's alpha reliability of .77.

2.3.2.5. Relational risk: Mother–child attachment: Child attachment was assessed at 12 months using the Strange Situation (Ainsworth, Blehar, Waters, & Wall, 1978). The children's behavior in the videotaped interactive sequence was coded into insecure-avoidant (A), secure (B), and insecure-ambivalent (C) categories according to the procedures outlined by Ainsworth et al. (1978) and an insecure-disorganized/disoriented (D) category according to Main and Solomon (1990). Two individuals trained by the second author independently coded the Strange Situation videos. Differences were resolved by consensus in consultation with the second author. Before conferencing, interrater agreement on the A, B, C, and D categories was 82% ($\kappa = .74$). Mother–child relationship was coded 1 for insecurely attached children (A, C, and D), which consisted of 46% of the sample, and 0 for securely attached children (B).

2.3.2.6. Child characteristics: Because child sex has historically been associated with child language performance with mixed findings (Morisset et al., 1995), we included it as a potential risk factor. Sex of the child was coded 0 for female (45%) and 1 for male (55%).

3. Results

3.1. Data reduction: Latent profile analysis

The intent of this analysis was to identify subgroups of respondents who provided qualitatively different linguistic environments to their children from age 12 months to 30 months, an important developmental period for child language development. Maternal linguistic environmental risk was measured by eight variables: NCATS maternal warmth and NCATS cognitive stimulation at 12, 18 and 30 months of age and HOME linguistic environment at 12 and 24 months of age. All eight variables were used as indicators of a latent categorical factor in a “person centered” approach to the data, in this case a latent profile analysis. A person centered or pattern centered analysis often entails categorization of individuals based on some criteria in order to identify homogenous sub-groups that are of theoretical interest (Magnusson, 1998). Latent profile analysis is based on the assumption that the relationship among continuous indicators can be “explained” by an unobserved categorical latent construct, such that the indicators are said to be locally independent with respect to the latent construct (McCutcheon, 1987). Latent profile analysis, based on mixture modeling, is a method designed to divide the population under study into a set of latent sub-populations that share a distinct interpretable pattern of relationships among the indicators (Meiser & Ohrt, 1996).

The latent profile analysis was accomplished using MPLUS version 3.01. The model was specified such that the means and variances among the indicators were estimated within each class while the correlations between indicators were not estimated, thus specifying a latent profile model. The software provides the Bayesian Information Criterion [*BIC*]; the best fitting model will have the lowest *BIC* value. Additionally, the Lo-Mendall-Rubin likelihood ratio test of model fit was used; it compares the estimated model with a model that has one less class (Lo, Mendell, & Rubin, 2001). The Lo-Mendall-Rubin gives a *p*-value that is the probability that a model with one less class generated the data, i.e., a low *p*-value indicates the estimated model fits the data better than one with one less class (Muthen & Muthen, 2004). The number of latent classes is determined iteratively, specifying an increasing number of classes and examining the output, interpretability of the results, meaningfulness of classes, *BIC* values, and the Lo-Mendall-Rubin test of model fit (Muthen & Muthen, 2004).

Model testing began with the specification of a one-class model with the eight indicators of maternal linguistic environment. Next, two-class and three-class models were tested and the *BIC* value was compared (*BIC* value 4822 and 4795, respectively) indicating that the three-class model fit the data best. The Lo-Mendell-Rubin likelihood ratio test of model fit indicated that a two-class model fit significantly better than a one-class model ($p < .001$). However, a three-class model had a marginal *p*-value of .07 when comparing the three class model to a two-class model. Upon examination of the two- and three-class models, we chose the two-class solution. The three-class solution essentially retained the lowest linguistic environmental class already identified in the two-class solution and divided the average linguistic environmental class into two groups, average and higher quality linguistic environment. For the purpose of this paper, however, we were most interested in those at greatest risk due to poorer linguistic environments. It served our purposes to qualify two groups, those with the lowest levels of linguistic environment resources ($n = 35$), which we denote as the high-risk group, compared to all others ($n = 119$). The average class probabilities for the two-class solution by class were very good (.97, .97, for classes 1 and 2, respectively) suggesting clearly defined classes; the entropy for this model was .90. Sample means and standard deviations for the full sample and by linguistic environmental groups are presented in Table 2.

The results indicate that the two groups were substantively and statistically different on every indicator. A follow-up multivariate analysis of variance in which the eight profile indicators were dependent variables indicated that the two groups (average and high-risk) were significantly different $F(8, 145) = 40.44$, $p \leq .001$. On average, the high-risk group was close to one standard deviation below the full sample mean on all the indicators, indicating that the high-risk group provided a qualitatively different language-learning environment during the developmental period from 12 to 30 months of age. The importance of identifying this group is that it represents an overall categorization of respondents who provided a less than optimal linguistic environment for their children throughout the early stages of language development.

3.2. Model reduction: Potential predictors of low PLS functioning

The proposed model includes several domains of risk including maternal verbal ability (genetic/environmental risk), intergenerational risk, contextual risk, home environmental risk, relational risk, and child characteristics. We examined these potential predictors of child language performance at 54 months of age, and reduced the set of predictor variables with variable selection procedures recommended by Hosmer and Lemeshow (2000), which reduce predictors in a generous stepwise fashion to avoid over fitting the logistic regression model.[1] Both the descriptive data for the full sample and the initial chi-square analysis, which was followed by blocks of logistic regressions analyses, for each domain of risk under study are presented in Table 1. We retained only those variables that were at least marginally associated ($p \leq .20$) with the outcome of interest, dichotomized child language scores on the PLS. Consistent with these procedures the following risk factors were retained in the multivariate logistic regression model: low maternal verbal ability, grandparent welfare, maternal education, and high-risk linguistic environment. Risk factors that were not retained included grandmother's education, maternal public assistance, and maternal young age at birth, insecure attachment, and male sex.

It is interesting that insecure attachment was not associated with PLS language scores as this association has been found in the literature (van IJzendoorn et al., 1995). Similarly, sex differences did not emerge in this study, which is not as unexpected since there are mixed findings with regard to sex differences and vocabulary performance in the literature (Morisset et al., 1995). As a follow-up to these results, an independent sample *t*-test was conducted using the continuous PLS total combined standardized score as the outcome to examine if the categorization of the PLS score into a dichotomous variable obscured potential differences. Males ($M = 91$, $SD = 20$) did not have significantly lower scores than females ($M = 95$, $SD = 19$), ($p = .18$). Insecurely attached children ($M = 92$, $SD = 20$) did not perform more poorly than securely attached children ($M = 93$, $SD = 20$) ($p = .76$) on the continuous PLS total combined standardized score. Finally, an ANOVA indicated that secure, insecure avoidant type, insecure anxious type and insecure disorganized type did not differ from each other $F(3, 142) = .24$, $p = .89$ on the PLS total combined standardized score.

3.3. Logistic regression: Full model and test of moderation by maternal verbal ability

A multivariate logistic regression analysis demonstrated that the most relevant predictors of below average PLS scores of children prior to school entry were low maternal verbal ability, with an odds ratio (*OR*) of 4.55, and high-risk linguistic environment, with an *OR* of 3.05. Both of these predictors were significant, controlling for maternal education and grandparent on welfare, for which neither were significant (Table 3). High-risk home environment exhibited a significant association with low PLS scores after accounting for the effects of potential genetic influences of low maternal verbal ability. However, this finding was qualified by the investigation of the dual risk hypothesis reported in the next section.

The next logistic regression analyses examined whether low maternal PPVT moderated the effect of high-risk linguistic environment. The full logistic regression model was run for two groups, those who had below average maternal verbal ability scores and those who had average or above average maternal verbal ability scores. These results demonstrated, as expected, that the risk of a low quality linguistic environment in the home was most detrimental to those children whose mothers were below average on the PPVT, with a highly significant and substantively meaningful *OR* of 7.04 (see Table 4). For the group of children whose mothers

[1]In addition to model reduction procedures, we verified all the relationships between all risk factors in their continuous form and the continuous score of child PLS at 54 months of age; all of the relationships were confirmed using both scoring methods (continuous and dichotomous). Thus, univariate relationships identified remained regardless of scoring method.

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had average performance on the PPVT, the high-risk linguistic home environment was not a significant predictor of the children's below average PLS. All of the other risk factors remained nonsignificant for both groups.

Finally, a cross-tabulation between maternal verbal ability group membership and high-risk linguistic environment was significant (see Table 5). Low verbal ability mothers tended to provide a high-risk linguistic environment while those mothers with at least average verbal ability were less likely provide a high-risk linguistic environment.

As an illustration of the combined effect of both low maternal verbal ability and high-risk linguistic environment, we created four groups based on these two risk factors: no risk (n = 73), high-risk linguistic environment only (n = 10), low maternal verbal ability only (n = 46), and both high-risk linguistic environment and low maternal verbal ability (n = 25). Fig. 1 presents the means for each group on the continuous Standardized PLS Total Combined Score; a 2 × 2 ANOVA revealed a main effect of maternal PPVT group, $F(1, 150) = 34.4$, $p < .001$, an effect of linguistic environment class that approached significance, $F(1, 150) = 3.1$, $p = .08$, and a significant linguistic environment by maternal PPVT group interaction, $F(1, 150) = 4.4$, $p < .05$. Those children who were exposed to both a high-risk linguistic environment and low maternal verbal ability had a significantly lower standardized score compared to all other groups. Clearly, children with both risk factors performed substantially below the other groups with an average standardized score of 74; moreover, they were one and two-thirds standard deviations below the population mean of 100. In order to test whether the 25 children exposed to both a high-risk linguistic environment and low maternal verbal ability had mothers with significantly impaired verbal ability compared with all other groups, a 2 × 2 ANOVA was performed with maternal PPVT as the continuous dependent variable, and linguistic environment and child PLS category as the two factors. As expected, both main effects were significant, but their interaction was not, $F(1, 148) = .57$, $p = .44$. Therefore, it was not the case that the poor language performance of the children in the dual risk group was due to the especially low verbal ability of their mothers.

4. Discussion

This study examined a comprehensive set of potential predictors of preschool language skills at 54 months of age in a sample of children of adolescent mothers. The proposed model included several domains of risk including maternal verbal ability, and intergenerational, contextual, home environmental, relational and child characteristics. Univariate examination of potential risk factors eliminated several of the proposed variables including child sex, mother on public assistance, grandmother education, and child attachment security. The first logistic regression model that was examined included maternal ability as measured by the PPVT, grandparent on welfare during the year prior to respondent's teen pregnancy, maternal education achieved in young adulthood, and high-risk linguistic environment measured during the early formative years of language development from 12 months to 30 months. The results indicated that low maternal ability and high-risk linguistic environment were significant predictors of child below-average language performance at 54 months of age. Findings from the present study thus confirm that a poor quality linguistic home environment is a significant predictor of low performing preschoolers' language even after controlling for those contributions of maternal verbal ability, intergenerational risk, and maternal education.

However, as the test of moderation indicated, this effect was only relevant for those children whose mothers were performing below average in *their own* verbal abilities. Low maternal language ability moderated the effect of the home environment, such that the high-risk linguistic home environment was only significant for those children whose mothers' verbal performance was at least one standard deviation below the mean. For children with mothers who scored at least average on their verbal ability, the quality of the home environment was not associated with a below average performance on PLS at 54 months of age. Similar to the initial logistic regression, the effects of grandparent welfare and maternal education were not significant in the test of moderation. Finally, our expectation that those mothers with lower performance on the PPVT were more likely to be categorized as having a higher-risk linguistic home environment was confirmed.

Together, these findings support the potential for maternal verbal abilities to be an important moderator of the home environment and thus a potentially robust indicator of risk in clinical assessment. We suggest this because 25 of the 35 cases classified as “high-risk linguistic home environment” during the time when children are rapidly developing new language skills were mothers who also scored below average on the PPVT. On the other hand, it is also important to note that of the 71 mothers with below average PPVT, only 25 were also providing a poor linguistic environment. Although it was the case that these 25 mothers had lower PPVT standardized scores (M = 68.5, SD = 8.6) than the low-PPVT mothers who did not provide a poor linguistic environment (M = 76.8, SD = 7.0), the final ANOVA performed with the continuous maternal PPVT score as the dependent variable suggested that this does not account for the dual-risk finding. Instead, these results highlight the importance of targeting this low-functioning group for intervention. Clearly, Fig. 1 demonstrates the importance of the combination of low maternal vocabulary and high-risk home linguistic environment; children exposed to both risk factors were more than one and two-thirds standard deviations below the normed population mean and below other children in this sample of adolescent mothers, and were clearly at risk for difficulty in their transition into formal schooling. Consequently, at pregnancy, long before observations of the home environment are possible, low, and especially *very* low, maternal language scores serve as an important indicator of things to come. Early intervention and services would likely be robust for this sub-population since it is within this group that the high-risk linguistic environment was both observed and found to be disadvantageous.

It is commonly acknowledged that the association of mother's verbal intelligence with early child language performance reflects both genetic determinants as well as the more stimulating interactions in the home provided by mothers with higher verbal ability (Scarr, 1998). Importantly for intervention, the contribution of the environment to cognitive and language outcomes in the toddler and preschool years is generally higher than the contribution of heredity (Young, Schmitz, Corley, & Fulker, 2001). Moreover, it may be within the highest risk populations that changes to environment have their most robust effect (Rowe, Jacobson, & Van den Oord, 1999). A focused, environmental intervention to enhance the language-learning environment in the home as well as in other potential contexts, such as childcare, would be especially beneficial for children of mothers with low verbal ability.

This was primarily a healthy sample at birth. It was also a sample that was not receiving many early intervention services. Only three mothers reported at 3 years postpartum that the child was receiving services for a developmental disability or delay. Based on their language performance at 54 months, many more children by this age would qualify for services, with 24% scoring 77 (1.5 SD) or below on the total PLS.

Given the significance of academic success in our culture, and the resulting societal benefits from academic performance, improvements in a child's preparedness for school entry should be facilitated for those children at the greatest risk of school failure. Although poor language ability may not be problematic within a community or family unit, when a child moves beyond the immediate family and community setting into the academic environment, poor initial performance may lead to a longer-term trajectory of poor performance throughout the early elementary school years (Walker et al., 1994). Consequently, finding appropriate interventions specific to the particular needs of high-risk populations is a necessary task for those interested in the prevention of school failure and associated outcomes. Whitehurst and Lonigan (1998) noted that promoting emergent literacy in preschool is so important because it “is not that children with low levels of those skills cannot succeed in the task of learning to read. Rather, the reason is that schools provide an age-graded rather than skills-graded curriculum in which early delays are magnified at each additional step as the gap increases between what children bring to the curriculum and what the curriculum demands” (p. 865).

The policy and intervention implications of these findings are that it is possible to alter the course of school performance of those children nested in the highest risk families. Given the general population and the normally distributed scores of the PPVT, we would expect approximately 16% of the sample to be one standard deviation below the mean, but in this sample almost half (46%) of the mothers were at least one standard deviation below the mean. In addition, the adolescent mothers in this sample had a variety of other risk factors present, which further supports the importance of advocating for both intervention delivery services and effective policy strategies to provide additional services for this population. The question remains: if services are available, what form should they take? How might programs intervene with this population?

Several interventions developed over the last two decades to improve language performance in the early preschool years focus on maternal and child language interaction specifically related to storybook reading. In a comprehensive meta-analysis, Bus, van IJzendoorn and Pellegrini (1995) found that parent–preschooler book reading is a robust predictor of language, emergent literacy, and reading achievement with at least moderate effects sizes. Research has shown that a particular style of storybook reading, called dialogic reading, promotes language and other emergent literacy skills (Whitehurst et al., 1994). Dialogic reading promotes the child's active engagement with the book, rather than passive listening. Adult dialogic readers are instructed, for example, to encourage the child to be involved in the story though open-ended questions and reinforcement.

It is unclear, however, how dialogic reading interventions operate within different populations such as those of children of adolescent mothers, or with mothers who have below average verbal ability, or both. Adolescent mothers likely have qualities, related to their cognitive and emotional immaturity, that are different from older mothers from similar backgrounds and which may influence their receptivity to intervention approaches (Dahl, 2004; Shapiro, 2003). Consequently, interventions designed to improve preschool language and emerging literacy practices need evaluation for applicability in high-risk sub-groups—such as those adolescent mothers with below average language or cognitive attainment and potentially a host of other risk factors and developmental issues.

Whitehurst et al. (1994) recognized that the limitations of dialogic storybook reading are that it is dependent on both the ability of the adult to facilitate dialogic reading and to be committed to reading on a regular basis. Consequently, interventions provided to this subpopulation may need complementary services to support the overall family functioning and reduce risks associated with impoverished environments. Another approach to improve overall child development and cognitive skills is based on the early childhood care and education (ECCE) program models. ECCE programs are developed to enhance the developmental and cognitive outcomes of children who are socially or economically disadvantaged. A review of 36 experimental studies aimed at assessing the long-term effects of early childhood programs that typically included preschool, childcare and/or parenting services, found that there was “overwhelming” evidence to show improvements in reducing special education placement and grade retention along with moderately persistent effects on achievement, high school graduation, and socialization (Barnett, 1995).

One intervention study of low income African American adolescent mothers found highly significant intervention effects for their Parent Education Program which focused on maternal education (in math, English, and child development classes) and maternal and child interaction in play and story reading (McQueen & Washington, 1988). McQueen and Washington found that the Parent Education Program increased children's PPVT scores by 20 months in a three month period while also increasing maternal PPVT score by more than a standard deviation relative to the comparison groups (although in this sample the mothers had a pretest mean of 101 on their standardized PPVT score at the start of the study, so they did not have low verbal abilities to start). However, in this study the children in both the intervention and control groups received high quality childcare, suggesting childcare alone may not be sufficient and a more comprehensive approach may be necessary. There is a shortage of intervention studies that focus on intervention with low language or low IQ mothers. One such study has looked at the effectiveness of parent training in the promotion of enhanced interaction, verbalization, and engagement of planned activities on mothers at risk for maltreatment (Bigelow & Walker, 2005). This small sample (N = 7) of adult mothers (age 19 or older) had average standardized PPVT score of 72. The intervention provided a series of language promotion strategies and planned activities. Posttests revealed enhanced child verbalization and maternal engagement in language promotion strategies, although longer term outcomes have not been assessed. The intervention strategies were specifically designed to meet the needs of low language performing mothers; these strategies included teaching parents to use language promoting strategies such as following children's lead, maternal responsiveness, commenting and labeling, expanding upon child vocalizations, and asking open ended questions (Bigelow & Walker, 2005). For the lowest language performing mothers, those with developmental disabilities, strategies were broken down into its simplest version such as naming an object versus describing the color or a characteristic of an object (K. Bigelow, 2005, personal communication). Consequently, there are methods that may be used to adjust interventions for both adolescent mothers and low language ability adolescent mothers, but a comprehensive approach that addresses the developmental needs of the adolescent mother, the context within which she is living, and her own language resources is needed, as others have already noted (Brooks-Gunn, Berlin, & Fuligni, 2000).

This study has both strengths and limitations. One of the main strengths of this study is that it used a large, diverse, and prospective longitudinal sample of adolescent mothers who were not selected from a clinical population. Multiple measures were collected, including laboratory assessments of insecure attachment using the Strange Situation, home observations conducted by trained interviewers at several time points, and standardized measures of both maternal and child verbal performance. Moreover, model fitting was approached systematically in order to reduce potential overfitting.

Two limitations in particular are worth noting. In this sample, respondents' dependence on public assistance over time was a cumulative measure of poverty status, and while it was useful, it may underestimate poverty by not capturing those who were the working poor, individuals not on public assistance as their main source of income but who, nevertheless, may not have the resources to meet their basic needs. For the same reasons, then, the measure of grandparent use of public assistance as an indicator of intergenerational poverty has limitations. Finally, the sample, although it was diverse, was not a random sample and the findings need to be replicated on other samples for further generalization. The limitations notwithstanding, this study adds to our understanding of the home environment of children in at risk populations and suggests several potential avenues of intervention.

Finally, an important area for research is to assess, to the degree possible, current and past interventions and their effects as they interact with maternal cognitive/verbal resources. For programs that have shown success in improving preschool-age children's language and emergent literacy, further assessment within sub-populations would be highly informative. Are intervention effects specific to mothers who have at least average cognitive or language performance? Conversely, do programs perform equally well between groups based on cognitive or language performance of the adult caregiver? In their review of the literature on the effects of low maternal intelligence on child intelligence, Kelly et al. (1996) argue that there are special requirements for interventions that are delivered to groups with below average cognitive performance. For example, participants may not understand written intervention material; they may need greater reinforcement and more opportunities for repetition. For this subpopulation, Kelly et al. (1996) argue that sensitive and supportive practitioners should conduct interventions within the home, tailor their content, and, if possible, maintain the intervention throughout early childhood to mitigate the potential of a child falling behind once formal schooling has started.

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References

Ainsworth, M. D., Blehar, M. C., Waters, E., & Wall, S. (1978). *Patterns of attachment: A psychological study of the Strange Situation.* Hillsdale, NJ: Erlbaum.

Baldwin W, Cain V. The children of teenage parents. Family Planning Perspectives 1980;12:34–43. [PubMed: 7364020]

Barnard, K. E. (1979). *Nursing child assessment teaching scale.* Instructor's learning resource manual Seattle, WA: University of Washington.

Barnett WS. Long-term effects of early childhood programs on cognitive and school outcomes. Future of Children 1995;5(3):25–50.

Barratt MS, Roach MA. Early interactive processes: Parenting by adolescent and adult single mothers. Infant Behavior & Development 1995;18(1):97–109.

Baumwell L, Tamis-LeMonda CS, Bornstein MH. Maternal verbal sensitivity and child language comprehension. Infant Behavior & Development 1997;20(2):247–258.

Bigelow, K., & Walker, D. (2005, April). Teaching language-promoting strategies and planned activities training to parents at risk for child maltreatment. *Poster session presented at the biennial meeting of the Society for Research in Child Development, Atlanta, GA*

Boyer D, Fine D. Sexual abuse as a factor in adolescent pregnancy and child maltreatment. Family Planning Perspectives 1992;24(1):4–19. [PubMed: 1601126]

Bradley, R. H., & Whiteside-Mansell, L. (1997). Children in poverty. In R. T. Ammerman & M. Hersen (Ed.), *Handbook of prevention and treatment with children and adolescents: Intervention in the real world context* (pp. 13–58). New York, NY: John Wiley & Sons.

Broman, S. H. (1981). Long-term development of children born to teenagers. In K. Scott, & T. Field & E. Roberston (Eds.), *Teenage parents and their offspring* (pp. 195–224). New York: Grune & Stratton.

Brooks-Gunn, J. (1990). Adolescents as daughters and as mothers: A developmental perspective. In I. E. Sigel & G.H. Brody (Ed.), *Methods of family research: Biographies of research projects: Vol. 1. Normal Families* (pp. 213–248). Hillsdale, NJ: Erlbaum.

Brooks-Gunn, J., Berlin, L. J., & Fuligni, A. S. (2000). Early childhood intervention programs: What about the family? In J. P. Shonkoff & S.J. Meisels (Ed.), *Handbook of early childhood intervention* (2nd ed.) (pp. 549–588). New York, NY: Cambridge University Press.

Burchinal MR, Roberts JE, Hooper S, Zeisel SA. Cumulative risk and early cognitive development: A comparison of statistical risk models. Developmental Psychology 2000;36(6):793–807. [PubMed: 11081702]

Bus AG, van IJzendoorn MH, Pellegrini AD. Joint book reading makes for success in learning to read: A meta-analysis on intergenerational transmission of literacy. Review of Educational Research 1995;65(1):1–21.

Caldwell, B., & Bradley, R. (1984). *Home observation for measurement of the environment.* Little Rock, AR: University of Arkansas.

Chase-Lansdale P, Brooks-Gunn J, Paikoff RL. Research and programs for adolescent mothers: Missing links and future promises. American Behavioral Scientist 1992;35(3):290–312.

Coley RL, Chase-Lansdale P. Adolescent pregnancy and parenthood: Recent evidence and future directions. American Psychologist 1998;53(2):152–166. [PubMed: 9491745]

Culp AM, Hubbs-Tait L, Culp RE, Starost HJ. Maternal parenting characteristics and school involvement: Predictors of kindergarten cognitive competence among Head Start children. Journal of Research in Childhood Education 2001;15(1):5–17.

Dahl RE. Adolescent brain development: A period of vulnerabilities and opportunities. Keynote address. Annals of the New York Academy of Sciences 2004;1021:1–22. [PubMed: 15251869]

Deal LW, Holt VW. Young maternal age and depressive symptoms: Results from the 1988 National Maternal and Infant Health Survey. American Journal of Public Health 1998;88(2):266–270. [PubMed: 9491019]

Dollaghan CA, Campbell TF, Paradise JL, Feldman HM, Janosky JE, Pitcairn DN, et al. Maternal education and measures of early speech and language. Journal of Speech, Language, and Hearing Research 1999;42(6):1432–1443.

Dubow EF, Luster T. Adjustment of children born to teenage mothers: The contribution of risk and protective factors. Journal of Marriage & the Family 1990;52(2):393–404.

Duncan GJ, Brooks-Gunn J, Klebanov PK. Economic deprivation and early childhood development. Child Development 1994;65(2):296–318. [PubMed: 7516849]

Dunn, L. M., & Dunn, L. M. (1981). *Peabody picture vocabulary test-revised.* Circle Pines, MN: American Guidance Service.

Furstenberg, F. F. J., Brooks-Gunn, J., & Morgan, S. P. (1987). *Adolescent mothers in later life.* New York: Cambridge University Press.

Guo G, Harris KM. The mechanisms mediating the effects of poverty on children's intellectual development. Demography 2000;37(4):431–447. [PubMed: 11086569]

Hann DM, Osofsky JD, Culp AM. Relating the adolescent mother–child relationship to preschool outcomes. Infant Mental Health Journal 1996;17(4):302–309.

Hardy J, Welcher D, Stanley J, Dallas J. Long-range outcome of adolescent pregnancy. Clinical Obstetrics and Gynecology 1978;21(4):1215–1232. [PubMed: 737929]

Hart, B., & Risley, T. R. (1995). *Meaningful differences in the everyday experience of young American children.* Baltimore, MD: Paul H. Brookes Publishing Co.

Hill, S. L. (2000). *Language, behavior, and neurodevelopmental delay in children of adolescent mothers* Unpublished Dissertation, University of Washington, Seattle, WA.

Hoff-Ginsberg E. Maternal speech and the child's development of syntax: A further look. Journal of Child Language 1990;17(1):85–99. [PubMed: 2312647]

Hoffman SD. Teenage childbearing is not so bad after all…or is it? A review of the new literature. Family Planning Perspectives 1998;30(5):236–243. [PubMed: 9782047]

Hoffman, L. W. (2003). Methodological issues in the studies of SES, parenting, and Child Development. In M. H. Bornstein & R.H. Bradley (Ed.), *Socioeconomic status, parenting, and child development. Monographs in parenting series* (pp. 125–143). Mahwah, NJ: Erlbaum.

Horwitz SM, Klerman LV, Kuo S, Jekel JF. Intergenerational transmission of school-age parenthood. Family Planning Perspectives 1991;23(4):168–172. [PubMed: 1936218]

Hosmer, D. W., & Lemeshow, S. (2000). *Applied logistic regression* (2nd ed.). New York: John Wiley & Sons, Inc.

Kazdin AE, Kraemer HC, Kessler RC, Kupfer DJ, Offord DR. Contributions of risk-factor research to developmental psychopathology. Clinical Psychology Review 1997;17(4):375–406. [PubMed: 9199858]

Kellam S, Ensminger M, Turner RJ. Family structure and the mental health of children. Archives of General Psychiatry 1977;34(9):1012–1022. [PubMed: 901133]

Keller TE, Spieker SJ, Gilchrist L. Patterns of risk and trajectories of preschool problem behaviors: A person-oriented analysis of attachment in context. Development and Psychopathology 2005;17(2): 349–384. [PubMed: 16761549]

Kelly JF, Morisset CE, Barnard KE, Patterson DL. Risky beginnings: Low maternal intelligence as a risk factor for children's intellectual development. Infants and Young Children 1996;8(3):11–23.

Keown LJ, Woodward LJ, Field J. Language development of pre-school children born to teenage mothers. Infant and Child Development 2001;10(3):129–145.

Kinard, E. M., & Klerman, L. V. (1983). Effects of early parenthood on the cognitive development of children. In E. McAnarney (Ed.), *Premature adolescent pregnancy and parenthood* (pp. 253–266). New York: Grune & Stratton.

Kinard EM, Reinherz H. Behavioral and emotional functioning in children of adolescent mothers. American Journal of Orthopsychiatry 1984;54(4):578–594. [PubMed: 6507595]

La Paro KM, Pianta RC. Predicting children's competence in the early school years: A meta-analytic review. Review of Educational Research 2000;70(4):443–484.

Lo Y, Mendell N, Rubin D. Testing the number of components in a normal mixture. Biometrika 2001;88:767–778.

Luster T, Bates L, Fitzgerald H, Vandenbelt M, Key JP. Factors related to successful outcomes among preschool children born to low-income adolescent mothers. Journal of Marriage and the Family 2000;62(1):133–146.

Luster T, McAdoo H. Family and child influences on educational attainment: A secondary analysis of the High/Scope Perry Preschool data. Developmental Psychology 1996;32(1):26–39.

Luster T, McAdoo HP. Factors related to the achievement and adjustment of young African American children. Child Development 1994;65 (4):1080–1094. [PubMed: 7956466]

Luster T, Vandenbelt M. Caregiving by low-income adolescent mothers and the language abilities of their 30-month-old children. Infant Mental Health Journal 1999;20(2):148–165.

Magnusson, D. (1998). The logic and implications of a person-oriented approach. In L. R. B. R. B. Cairns, & J. Kagen (Eds.), *Methods and models for studying the individual* (pp. 33–64). Thousand Oaks, CA: Sage.

Main, M., & Solomon, J. (1990). Procedures for identifying disorganized/disoriented infants in the Ainsworth Strange Situation. In M. Greenberg, D. Cicchetti, & M. Cummings (Eds.), *Attachment in preschool years: Theory, research, and intervention* (pp. 121–160). Chicago, IL: University of Chicago Press.

McCutcheon, A. L. (1987). *Latent class analysis.* Newbury Park, CA: Sage.

McQueen AB, Washington V. Effect of intervention on the language facility of poor, Black adolescent mothers and their preschool children. Early Child Development and Care 1988;33:137–152.

Meiser T, Ohrt B. Modeling structure and chance in transitions: Mixed latent partial Markov-chain models. Journal of Educational and Behavioral Statistics 1996;21(2):91–109.

Miller-Johnson S, Winn DM, Coie J, Maumary-Gremaud A, Hyman C, Terry R, et al. Motherhood during the teen years: A developmental perspective on risk factors for childbearing. Development and Psychopathology 1999;11(1):85–100. [PubMed: 10208357]

Moore, K. A., Morrison, D. R., & Greene, A. D. (1997). Effects on the children born to adolescent mothers. In R. A. Maynard (Ed.), *Kids having kids: Economic costs and social consequences of teen pregnancy* (pp. 145–173). Washington, DC: The Urban Institute Press.

Moore KA, Snyder NO. Cognitive attainment among firstborn children of adolescent mothers. American Sociological Review 1991;56(5):612–624.

Morisset CE, Barnard KE, Booth CL. Toddlers' language development: Sex differences within social risk. Developmental Psychology 1995;31(5):851–865.

Morrow, L. M. (2001). Literacy development and young children: Research to practice. In S. L. Golbeck (Ed.), *Psychological perspectives on early childhood education: Reframing dilemmas in research and practice The Rutgers invitational symposium on education series* (pp. 253–279). Mahwah, NJ: Erlbaum.

Murray AD, Hornbaker AV. Maternal directive and facilitative interaction styles: Associations with language and cognitive development of low risk and high risk toddlers. Development and Psychopathology 1997;9(3):507–516. [PubMed: 9327236]

Muthen, B., & Muthen, L. K. (2004). *Mplus user's guide* (Third edition). Los Angeles, CA: Muthen & Muthen.

Neisser U, Boodoo G, Bouchard TJ, Boykin AW, Brody N, Ceci SJ, et al. Intelligence: Knowns and unknowns. American Psychologist 1996;51(2):77–101.

NICHD Early Child Care Research Network. Pathways to reading: The role of oral language in the transition to reading. Developmental Psychology 2005;41(2):428–442. [PubMed: 15769197]

Oxford ML, Gilchrist L, Morrison DM, Gillmore MR, Lohr MJ, Lewis SM. Alcohol use among adolescent mothers: Heterogeneity in growth curves, predictors, and outcomes of alcohol use over time. Prevention Science 2003;4(1):15–25. [PubMed: 12611416]

Rowe D, Jacobson K, Van den Oord E. Genetic and environmental influences on vocabulary IQ: Parental education level as moderator. Child Development 1999;70(5):1151–1162. [PubMed: 10546338]

Sameroff, A. (2000). Ecological perspectives on developmental risk. In J. D. Osofsky & H.E. Fitzgerald (Ed.), *WAIMH handbook of infant mental healthInfant Mental Health in Groups at High Risk, vol. 4* (pp. 1–33). New York: Wiley.

Scarr, S. (1998). How do families affect intelligence? Social environmental and behavior genetic predictions. In J. J. McArdle & R.W. Woodcock (Ed.), *Human cognitive abilities in theory and practice* (pp. 113–136). Mahwah, NJ: Erlbaum.

Seattle King-County Department of Public Health. (1998). Unpublished raw data. Epidemiology Planning and Evaluation Unit, Washington State Department of Health, Center for Health Statistics.

Senechal, M., & LeFevre, J. -A. (2001). Storybook reading and parent teaching: Links to language and literacy development. In P. R. Britto & J. Brooks-Gunn (Ed.), *The role of family literacy environments in promoting young children's emerging literacy skills New directions for child and adolescent development* (pp. 39–52). San Francisco, CA: Jossey-Bass.

Shapiro, J. R. (2003). A developmental perspective on adolescent parenting. In N. Farber (Ed.), *Adolescent pregnancy: Policy and prevention services* (pp. 127–151). New York: Springer Publishing Company.

Shonkoff, J. P., & Phillips, D. A. (2000). *From neurons to neighborhoods: The science of early childhood development.* Washington, DC: National Academy Press.

Smith C. The link between childhood maltreatment and teenage pregnancy. Social Work Research 1996;20(3):131–141.

Snow CE, Tabors PO, Nicholson PA, Kurland BF. SHELL: Oral language and early literacy skills in kindergarten and first-grade children. Journal of Research in Childhood Education 1995;10(1):37–48.

Tamis-LeMonda CS, Bornstein MH, Baumwell L. Maternal responsiveness and children's achievement of language milestones. Child Development 2001;72(3):748–767. [PubMed: 11405580]

Thomasgard, M., & Shonkoff, J. P. (1993). Mental retardation. In C. H. Zeanah Jr. (Ed.), *Handbook of infant mental health* (pp. 250–259). New York, NY: Guilford Press.

van IJzendoorn MH, Dijkstra J, Bus AG. Attachment, intelligence, and language: A meta-analysis. Social Development 1995;4(2):115–128.

Ventura, S. J., Martin, J. A., Taffel, S. M., Mathews, T. J., & Clarke, S. C. (1994). Advance report of the final natality statistics, 1992. *Monthly Vital Statistics Report*, *Vol. 43* Hyattsville, MD: National Center for Health Statistics.

Ventura, S. J., Martin, J. A., Taffel, S. M., Mathews, T. J., & Clarke, S. C. (1995). Advance report of the final natality statistics, 1993. *Monthly Vital Statistics Report*, *Vol. 44* Hyattsville, MD: National Center for Health Statistics.

Wadsworth J, Taylor B, Osborn A, Butler N. Teenage mothering: Child development at five-years. Journal of Child Psychology and Psychiatry 1984;25(2):305–313. [PubMed: 6707114]

Walker D, Greenwood CR, Hart B, Carta J. Prediction of school outcomes based on early language production and socioeconomic factors. Child Development 1994;65(2):606–621. [PubMed: 8013242]

Whitehurst GJ, Arnold DS, Epstein JN, Angell AL, et al. A picture book reading intervention in day care and home for children from low-income families. Developmental Psychology 1994;30(5):679–689.

Whitehurst GJ, Lonigan CJ. Child development and emergent literacy. Child Development 1998;69(3): 848–872. [PubMed: 9680688]

Whitman, T., Borkowski, J., Keogh, D., & Weed, K. (2001). *Interwoven lives: Adolescent mothers and their children.* Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Woodward L, Fergusson DM, Horwood LJ. Risk factors and life processes associated with teenage pregnancy: Results of a prospective study from birth to 20 years. Journal of Marriage & the Family 2001;63(4):1170–1184.

Young, S., Schmitz, S., Corley, R. P., & Fulker, D. W (2001). Language and cognition. In R. N. Emde & J.K. Hewitt (Ed.), *Infancy to early childhood: Genetic and environmental influences on developmental change* (pp. 221–240). New York: Oxford University Press.

Zimmerman, I. L., Steiner, V. G., & Pond, R. E. (1992). *Preschool Language Scale-3 examiner's manual.* New York: Psychological Corporation.

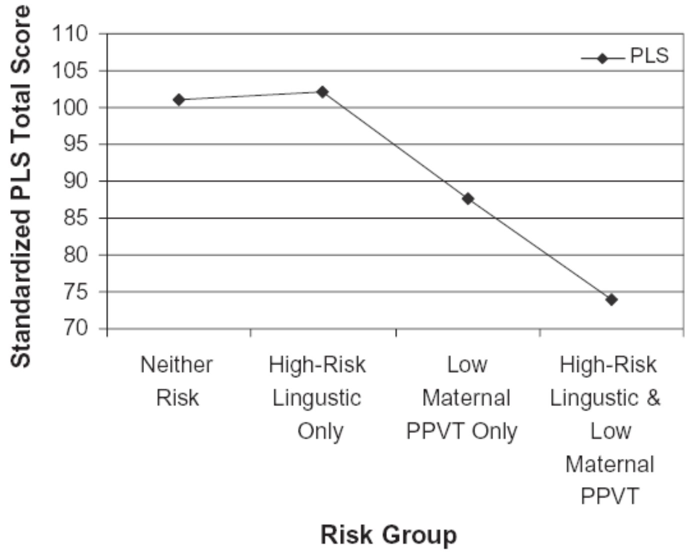

Fig. 1.
Standardized PLS total continuous score by for risk groups: High-risk linguistic environment, low maternal PPVT, both high-risk environment and low maternal PPVT, and neither risk factor.

Table 1

Associations between early risk factors and PLS groups, average and below average

Risk factors	Percent with risk factor in full sample	PLS > 85 (*n*=93)	PLS ≤ 85 (*n* = 59)	χ^2 (*df* = 1)
Maternal verbal ability				
Low maternal PPVT	46%	29%	72%	27.54***
Intergenerational risk				
Grandparent public assistance	41%	33%	53%	6.25*
Grandmother not HS graduate	22%	19%	25%	.60
Maternal contextual risk				
Age 16 or younger at pregnancy	63%	65%	62%	.07
Cumulative public assistance	55%	54%	57%	.66
Maternal education				χ^2 (*df* = 2)
No GED/High school	30%	22%	43%	8.33**
GED/High school graduate	55%	60%	48%	
Vocational or college	15%	18%	10%	
Home environmental risk				χ^2 (*df* = 1)
High risk linguistic environment	23%	12%	39%	15.88***
Relational risk				
Insecure attachment[a]	49%	47%	53%	.39
Child characteristics				
Male sex	55%	52%	59%	.81

* $p \le .05$.

** $p \le .01$.

*** $p \le .001$.

[a] Eight cases are missing attachment classification, *n* = 146.

Table 2

Latent profile results: mean (and *SD*) NCATS and HOME scores of the full sample and by linguistic environmental groups

Indicator	Age in months	Full sample		Average linguistic environment		High-risk linguistic environment	
		Mean	*SD*	Mean	*SD*	Mean	*SD*
NCATS							
Cognitive	12	11.26	2.90	12.25	1.97	7.88	3.06
	18	11.76	2.82	12.82	1.89	8.14	2.46
	30	12.70	1.99	13.12	1.87	11.27	1.75
Warmth	12	3.46	1.52	3.89	1.43	2.01	.71
	18	3.62	1.58	4.15	1.27	1.80	1.15
	30	3.72	1.46	3.98	1.28	2.84	1.70
HOME							
Linguistic	12	7.48	1.56	7.83	1.35	6.25	1.65
	24	7.53	1.23	7.77	1.09	6.73	1.36
Sample size		*N* = 154		*n* = 119		*n* = 35	

Note. NCATS=parent–child interactions as assessed by video taped assessment of Nursing Child Assessment Teaching Scale; HOME=Home Observation for Measurement of the Environment measure of cognitive stimulation and emotional support.

Table 3

Final model: Prediction of below average performance on PLS at age 54 months relative to those with average performance on PLS at age 54 months

	OR	**95% confidence interval**	
Grandparent public assistance	1.38	.63	2.99
Maternal PPVT<85	4.55***	2.13	9.71
Maternal education			
Vocational/college	—	—	—
GED/High school	1.39	.44	4.35
No GED/High school	2.20	.65	7.60
High risk linguistic environment	3.05*	1.23	7.53

Note. OR = Odds ratio.

* $p \leq .05$.

** $p \leq .01$.

*** $p \leq .001$.

Table 4

Final model test of moderation, predicting those with low performance on PLS, relative to average performance on PLS at age 54 months: Within low and within average functioning maternal verbal ability groups

	Maternal PPVT ≤ 85			Maternal PPVT > 85		
	OR	**95% confidence interval**		***OR***	**95% confidence interval**	
Grandparent public assistance	1.38	.46	3.83	1.44	.44	4.66
Maternal education						
Vocational/College	—	—	—	—	—	—
GED/High school	1.07	.18	6.21	1.86	.36	9.72
No GED/High school	1.32	.21	8.44	2.89	.47	17.82
High risk environment	7.04**	1.74	28.441	.98	.18	5.30

Note. OR = Odds ratio.

* $p \leq .05$.

** $p \leq .01$.

*** $p \leq .001$.

Table 5

Association between average and below average maternal verbal ability and low and high risk linguistic environment

	Maternal PPVT > 85 (*n* = 83)	**Maternal PPVT ≤ 85 (*n* = 71)**	**χ^2 (*df* = 1)**
Low-risk linguistic environment (*n* = 119)	73	46	11.69***
High-risk linguistic environment (*n* = 35)	10	25	

*** $p \leq .001$.

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