Ready or Not: Predicting High and Low School Readiness

Among Teen Parents' Children*

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Past research has documented compromised development for teenage mothers' children compared to others, but less is known about predictors of school readiness *among* these children or among teenage fathers' children. Our multidimensional measures of high and low school readiness incorporated math, reading, and behavior scores and parent-reported health. Using parent interviews and direct assessments from the Early Childhood Longitudinal Study-Birth Cohort, we predicted high and low school readiness shortly before kindergarten among children born to a teenage mother and/or father (N≈800). Factors from five structural and interpersonal domains based on the School Transition Model were measured at two time points, including change between those time points, to capture the dynamic nature of early childhood. Four domains (socioeconomic resources, maternal characteristics, parenting, and exposure to adults) predicted high or low school readiness, but often not both. Promising factors associated with both high and low readiness among teen parents' children came from four domains: maternal education and gains in education (socioeconomic), maternal age of at least 18 and fewer depressive symptoms (maternal characteristics), socioemotional parenting quality and home environment improvements (parenting), and living with fewer children and receiving nonparental child care in infancy (exposure to adults). The findings preliminarily suggest policies that might improve school readiness: encouraging maternal education while supplying child care, focusing teen pregnancy prevention efforts on school-age girls, basic socioeconomic supports, and investments in mental health and high-quality home environments and parenting.

KEYWORDS: Teen parenting, sociology, school readiness, School Transition Model, early childhood, life course, United States

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Teenage childbearing is common in the United States today, with 18% of all girls expected to give birth before age 20 (Perper & Manlove, 2009). After a long decline, the teen birth rate has stalled in recent years (Hamilton, Martin, & Ventura, 2010). Although the teen birth rate is much lower in other developed nations, it is a social problem of global concern. Decades of research have addressed this issue, including both its causes and its consequences for young parents and their children. Much of the research on the consequences of teenage parenthood for children has compared the children of teenage mothers to other children (e.g., Geronimus, Korenman, & Hillemeier, 1994; Levine, Pollack, & Comfort, 2001; Mollborn & Dennis, 2009; Moore & Snyder, 1991; Turley, 2003), while a smaller body of work has focused on understanding differences in outcomes *among* children of teenage parents (Dubow & Luster, 1990; Furstenberg, Brooks-Gunn, & Morgan, 1987a; Hubbs-Tait, Osofsky, Hann, & Culp, 1994; Luster, Bates, Fitzgerald, Vandenbelt, & Key, 2000; Luster, Lekskul, & Oh, 2004b). In this study we address three research questions that contribute to existing literature. *First*, why do some preschool-aged children of teenage parents end up well prepared to start school and others end up unprepared? This is an important question with clear policy implications, and we use a multidimensional construct of school readiness that includes early math and reading, behavior, and health. *Second*, are high and low levels of school readiness predicted by different factors, or do the same influences shape both? *Third*, how are the timing of and change in these factors across early childhood related to high and low levels of school readiness?

This study used data from the Early Childhood Longitudinal Study-Birth Cohort to identify children who were developmentally at risk at the start of the transition to school, as well as those who were quite successful across multiple domains of development. By understanding social structural and proximate factors associated with belonging in one of these groups, policymakers can better understand which children to target for interventions and which factors have potential for protecting them. We also measured each of these factors at two times points in early childhood and additionally examined change over that time span, to capture the dynamic nature of early life circumstances and their association with children's development.

Our second research question, which asks whether high and low levels of school readiness are shaped by distinct factors or by the same ones, required a different empirical approach than a typical means-based regression analysis. Regression models, which are widely used in this literature, assume that the associations between the independent and dependent variables are similar at higher and lower values of the dependent variable (i.e., that the relationships with the dependent variable are *linear*). Based on the literature reviewed below, we expect that some factors may predict either high or low levels of school readiness, but not both. For example, experiencing hunger is likely to predict unusually low levels of school readiness, but a lack of hunger is not expected to be associated with unusually high levels of school readiness compared to average levels. By predicting low and high levels of school readiness separately, we can test the assumption of linear relationships in regression analysis: that factors affect all levels of school readiness in the same way.

Using a relatively large subsample of children of teenage mothers and fathers on the cusp of the school transition (4½ years old), our binary logistic regression models predicted a child's odds of high school readiness (having good health and scoring near or above the mean for the population of U.S. children born in 2001 on behavior, reading, and math) and of low school readiness (having poor health or being well below the average for their peers on all three of these dimensions) compared to others. We conceptualized school readiness as a continuous phenomenon but set these cut points to delineate unusually high and low readiness from more average levels.

Drawing on the theoretical framework of the School Transition Model, we identified structural and interpersonal factors that may be related to the outcomes of teenage parents' children. Some of these risks are disproportionately common among these children because of young parental age or relative social disadvantage, and others (such as grandparents' coresidence or mothers' school enrollment) may have different consequences for teen parents' children compared to the general population. Previous studies have each examined part of the puzzle in understanding variation in the preschool outcomes of teenage mothers' children, but none included children of teenage fathers, and all used less recent or local data sources. We located one study that compared unusually high- and low-scoring preschool-aged children of teenage mothers (Luster et al., 2000). Although it explored a variety of potential predictors in a nuanced, multi-method analysis, Luster and colleagues' study was based on a small (N=44) local sample, did not differentiate processes predicting high versus low levels of readiness, and did not examine child outcomes beyond vocabulary scores.

1 Theory and Literature

1.1 Measuring School Readiness

Most schools implicitly use a "maturationist frame" (Snow, 2006) in declaring children ready for school by assuming that children of a certain chronological age are ready to succeed in school. Researchers and policymakers have questioned this framing of school readiness. For example, Blair (2002) takes a neurobiological approach instead, emphasizing the importance of emotion and self-regulation for children's school readiness and for the importance of low-stress environments in early

childhood for fostering such readiness. Lewit and Baker (1995) offer a definition of school readiness[1] but note that its measurement is not straightforward:

> The concept of school readiness tethers the notion of readiness for learning to a standard of physical, intellectual, and social development that enables children to fulfill school requirements and to assimilate a school's curriculum. Unfortunately, while some idea of a standard is nearly universal in readiness discussions, there is little agreement as to exactly what that standard should include. (129)

Snow (2006) reiterates that although research on school readiness has grown exponentially since this was written, "there is little consensus about a definition" (8). LaParo and Pianta (2000) note that individual cognitive abilities in preschool account for only about one quarter of the variance in academic achievement in early grade school, suggesting that contextual factors in the home and school maintain an important position in the understanding of readiness. Teachers identify *health* and *behavior*, and not just *academic preparedness*, as essential components of school readiness (Heaviside & Harris, 1993). Echoing this multidimensional focus, the Head Start Act requires Head Start programs to demonstrate children's gains in school readiness, operationalized as a variety of academic domains related to language, preliteracy, and prematheматics; social and emotional development; and (for nonnative speakers) progress in English language learning (Snow, 2006). As a recent example of an assessment meant to measure school readiness, Janus and Offord's (2002) Early Development Instrument, a teacher-completed school readiness measure, taps similar domains but adds physical health and well-being as a criterion.

Although there is some agreement about the variety of domains that should be included when assessing school readiness, most assessments and conceptualizations do not specify cut points that deem specific children to be ready or not ready for school. For example, the Early Development Instrument discussed above does not include diagnostic cutoffs. While the stakes for designating cut points are high when applied to decision-making about sending a child to school or retaining a child in grade, it is important and relatively less controversial for researchers to create identifiers of children as being approximately on track for school readiness versus not, in order to identify at-risk populations of children and factors that influence their high or low readiness.

Because it is extremely difficult to come up with a cohesive multidimensional measure of school readiness based on mastery of specific skills, we took a different approach. Our classification of school readiness included the cognitive, behavioral, and health dimensions outlined above, which we believe produces a measure in line with more comprehensive theoretical conceptions of readiness. Our classification of children with the lowest levels of health as having low levels of school readiness was absolute because of the likelihood that health problems would impair their school experience, whereas children were classified relative to age peers on the other domains. This was possible because the data we analyzed, the Early Childhood Longitudinal Study-Birth Cohort, were drawn from a nationally representative sample of children born in the United States in 2001. We knew where each child stood relative to age peers nationally, so we identified children who lagged substantially behind their peers in multiple domains as having low readiness, and those who performed near or above the national average in each domain as having high readiness. Rather than diagnostic cutoffs, these are identifiers for research purposes that facilitate a meaningful contribution to understanding heterogeneity in the outcomes of a particular at-risk population, teen parents' children. See below for more details.

[1] Some definitions of school readiness emphasize the readiness of the school to help children succeed and not just children's readiness for school (e.g., Graue, 1993), but like most researchers, we focus here on the child level.

1.2 The Transition to School Among Children of Teen Parents

This study focuses on the convergence of three domains of child development that have been shown to be important for children's successful transitions to school and long-term outcomes (Entwisle, Alexander, & Olson, 2004; Halonen, Aunola, Ahonen, & Nurmi, 2006; Weller, Schnittjer, & Tuten, 1992): academic preparedness, behavior, and health. They are all critical components of success in the *transition to school*, which determines a large part of children's academic outcomes throughout compulsory schooling (Baydar, Brooks-Gunn, & Furstenberg, 1993). Health and education in childhood work hand in hand to influence socioeconomic attainment and health in adulthood (Haas, 2007; Hayward & Gorman, 2004; Palloni, 2006; Ross & Wu, 1996). Crosnoe (2006) identified children's health as a key component of the transition to school. From past research we know that on average, children of teenage mothers approach the start of school at a disadvantage on each of these three dimensions (Geronimus et al., 1994; Levine et al., 2001; Mollborn & Dennis, 2009; Moore & Snyder, 1991; Turley, 2003). Some research on the causes of this disadvantage pinpoints preexisting factors, while other work identifies factors directly related to early childbearing. For example, teenage mothers have higher rates of preterm and low birth weight births than older mothers, outcomes that have been associated with compromised health and development in early childhood (Chen et al., 2007; Boardman et al., 2002; Boulet, Schieve, & Boyle, 2009). Late receipt of or lack of prenatal care and higher rates of smoking during pregnancy compared to older mothers may be among the factors that compromise birth outcomes for teenage mothers (Debiec et al, 2010; Hueston et al, 2008; Ventura et al., 2003). Much less is known about children of teenage fathers, though several of their preschool outcomes are also compromised compared to children with older fathers (Mollborn & Lovegrove, 2011).

In general, the preschool period is critical for children's futures (Chase-Lansdale, Gordon, Brooks-Gunn, & Klebanov, 1997; Mulligan & Flanagan, 2006). Cognitive, verbal, and behavioral outcomes from early childhood predict success when children start school (Baydar et al., 1993). In turn, children who start off doing well in elementary school tend to do better on later assessments of achievement, are more likely to complete high school, and attain higher levels of education than those who struggle at first (for a review, see Entwisle et al., 2004). Early language development has important influences on later reading, spelling, and language, and its influence remains stable throughout the first years of elementary school (Walker, Greenwood, Hart, & Carta, 1994) and for years afterwards (Baydar et al., 1993). For all of these reasons, children's readiness for the transition to school is critical, laying the groundwork for long-term socioeconomic and health inequalities (see Entwisle et al., 2004 for a review).

A variety of studies have shown that the children of teenage parents are at risk for compromised cognitive and behavioral development and health (Geronimus et al., 1994; Levine et al., 2001; Moore & Snyder, 1991; Turley, 2003). Teenagers are still developing psychologically and may not have the maturity that older parents have, so there may be disparities between teenagers' and adults' parenting styles and skills, home environments, and emotional resources that have developmental implications for their children (Furstenberg, Brooks-Gunn, & Chase-Lansdale, 1989). Teens are more likely than adults to engage in risky behaviors such as smoking, binge drinking, and delinquency that may endanger their children as well as themselves (Jessor, Donovan, & Costa, 1991). Teenage parents are also tackling the difficult task of parenting while concurrently working to build human capital by completing schooling or starting a career, which may put them at risk of being less successful in both of these domains. They are in a life phase when many teenagers enter into and terminate relationships with various partners as they gain experience with intimacy, potentially resulting in higher levels of partner instability that can negatively affect their children (Fomby & Cherlin, 2007; Osborne & McLanahan, 2007). These explanations deal with *average* differences between teenagers and older parents, but teen parents differ in the degree to which these

factors are present and negatively impact their children. Therefore, we expect *variation* among children of teen parents in the presence of these types of risks. Indeed, Vandenbelt, Luster, and Bates (2001) found that differences among low-income teenage mothers in home environments and parenting at age 4 predicted their children's achievement in first grade.

1.3 Theoretical Model

The *School Transition Model* (Alexander, Entwisle, Blyth, & McAdoo, 1988; further articulated by Crosnoe, 2006) provides a useful theoretical framework for organizing a variety of influences on children's school preparedness. In this model, children's *social structural circumstances*, such as socioeconomic resources, influence three domains of more proximate factors: *social psychological factors* (interpersonal relationships), *experiential factors* (experiences outside of family relationships), and *personal factors* (children's attributes such as personality). All of these factors influence children's cognitive achievement in the transition to school. We extend the model to encompass health and behavior. Crosnoe (2006) found that social structural factors influenced children's health, which in turn affected cognitive achievement. The same is true for behavior: Behavior problems indicate compromised social and/or emotional development, and such problems in early childhood are highly correlated with behavior problems and academic problems at school age (Halonen et al., 2006). While the School Transition Model predicts children's outcomes at the start of school, our study assesses them slightly earlier, at age 4½. Luster, Lekskul, and Oh (2004b) found that children's language scores at this age predicted first grade achievement test scores and teacher assessments of children's academic motivation.

One of the benefits of the School Transition Model is that it considers both *structural* and *proximate* factors to be important for understanding children's chances of success. Although many studies focus on one of these dimensions at the expense of the other, there is empirical support for taking a broader perspective. For example, research has found that maternal and family characteristics both matter for the outcomes of teenage mothers' children (Jaffee et al., 2001) and that these domains interact (Oxford & Spieker, 2006).

1.4 Focal Factors in the Theoretical Model

This study is novel in its joint consideration of a wide variety of indicators drawn from the School Transition Model that are hypothesized to influence a multidimensional operationalization of school readiness among teen parents' children from a nationally representative sample. Our hypotheses group potential influences on teenage parents' children's high and low levels of school readiness into categories, linked to various facets of the School Transition Model. Social structural hypotheses are followed by more proximate interpersonal, experiential, and personal influences that the model expects to be shaped by social structure. We cite past research justifying the inclusion of each set of factors, but no previous study has integrated them all for this population. This work contributes to research that has looked beyond child-centered approaches to readiness by examining the association between social contextual factors and readiness in the cognitive, behavioral, and health domains. We recognize that measuring these factors up to preschool is but one indicator of readiness, and that both individual characteristics and social context will continue to interact in the production of later academic success. We feel this work contributes by increasing understanding of the link between these elements among the children of teenage parents.

1.4.1 Socioeconomic resources. Socioeconomic resources are considered social structural factors in the School Transition Model. Cooley and Unger (1991) used the National Longitudinal Survey of Youth to estimate the effects of "family factors," including several resource measures, on the academic and behavioral outcomes of teenage mothers' children at ages 6 to 7. They found that these resources had important positive associations with development. In particular, family income is related to children's cognitive outcomes and behavior problems at age 3 to 5 (see Yeung, Linver, & Brooks-Gunn, 2002 for a review). Income has been linked to children's intellectual development

through cognitive stimulation in the home, parenting styles, the home's physical environment, and children's health status at birth (Guo & Harris, 2000). Maternal education is another socioeconomic resource that influences the development of teenage mothers' children (Cooley & Unger, 1991; Dubow & Luster, 1990; Luster et al., 2000; Luster, Bates, Vandenbelt, & Nievar, 2004a). Extreme deprivation also matters for development. For example, experiencing hunger has been linked to compromised behavioral and cognitive development in children (Kleinman et al., 1998).

1.4.2 Maternal characteristics. In the School Transition Model, mothers' age and their work and school involvement fall into the social structural category but have direct implications for children's interactions with their mothers. Past research has shown that younger teenage mothers and their children sometimes experience worse outcomes than older teenage mothers (Hoffman, Foster, & Furstenberg, 1993; Levine et al., 2001). Luster and colleagues (2000) found that children whose teenage mothers worked for pay were more likely to score very high than very low on vocabulary tests at age 4½. Mothers' mental health is considered a social psychological factor. Teenage mothers' depression is an important predictor of young children's behavior (Black et al., 2002a; Hubbs-Tait et al., 1994) and cognitive outcomes (Rosman & Yoshikawa, 2001).

1.4.3 Parenting and home environment. Parenting and home environment are considered social psychological factors in the School Transition Model. The quality of teenage mothers' parenting has been linked to the language development of their children at ages 2½ (Luster & Vandenbelt, 1999) and 4½ (Luster et al., 2000). The same two studies found home environment factors to be important predictors, as did Oxford and Spieker (2006). A factor related to parenting, the attachment bond between parent and child, has been associated with preschool behavior ratings by Hubbs-Tait (1994).

1.4.4 Parental relationships. The School Transition Model considers parental relationship characteristics to be social psychological factors. Both positive and negative aspects of parent figures' interactions have been found to be consequential for children's development. Black and colleagues (2002a) found that when teenage mothers assessed their partner interactions more negatively, their children were more likely to experience externalizing behavior problems at ages 4 to 5. Teenage mothers' reports of relationship strain with their child's father have been associated with higher levels of their depression and anxiety (Gee & Rhodes, 2003), which are linked to children's outcomes above. Beyond the dynamics within the parent figures' relationships, their stability also matters for children. The repeated entry and exit of a parent's romantic partners from a child's household has deleterious consequences for children's development, including their school readiness (Fomby & Cherlin, 2007; Osborne & McLanahan, 2007). Research on the effects of union stability has rarely addressed the children of teen parents in particular, but Cooley and Unger (1991) found that relationship stability was positively associated with the development of teenage mothers' children at 6 to 7 years old.

1.4.5 Exposure to adults. The factors in this final domain are considered social psychological in the School Transition Model, except for nonparental child care, which is an experiential factor because it often occurs outside the family. Brooks-Gunn and Furstenberg (1986) reported that much of the relationship between teenage motherhood and child outcomes was mediated by their higher likelihood of living in single-parent households, which lack the resources that extra adults in the household can provide. Although evidence is mixed, support from the child's father has generally been found to be beneficial for teenage mothers (Gee & Rhodes, 2003; see Roye & Balk, 1996 for a review) and their children (Black et al., 2002a; Cooley & Unger, 1991; Coren, Barlow, & Stewart-Brown, 2003; Luster et al., 2000). Living with the teen's parents potentially provides housing, child care, and financial resources, and it improves teenage parents' educational outcomes (Furstenberg & Crawford, 1978; Trent & Harlan, 1994). Although some evidence is mixed (Black et al., 2002b), living in a three-generation household with the child's maternal grandmother is generally thought to

be beneficial for teenage mothers' children's development, at least early in the child's life (Black et al., 2002b; Pope et al., 1993). Even if a grandmother does not live with the child, her involvement in child care in the child's first couple of years is positive for development at age 6 to 7 (Cooley & Unger, 1991). Additional adults in the household may be beneficial for children, but the presence of other children can be problematic (Luster et al., 2000). For mothers regardless of age, having more children leads to fewer available resources of time, money, and energy and less adult attention per child. Indeed, multiple teenage births have linked to greater levels of subsequent disadvantage (Furstenberg, Brooks-Gunn, & Morgan, 1987b).

1.5 Dynamic Processes Across Early Childhood

Early childhood is a time of rapid development and considerable change in many children's environments, so it is important to consider that the influence of each of these hypothesized domains may be dynamic over the course of early life. We measure each factor in infancy and at age 4½ unless repeat measures are not available. Because instability and change in children's environments have been linked to development above and beyond their situations at any given time point (Fomby & Cherlin, 2007; Osborne & McLanahan, 2007), we incorporate change over time in each factor as the child progresses from infancy through the later preschool years. Including these dynamic measures of each factor allows us to address the question of whether the timing of and change in these factors across early childhood are related to high and low levels of school readiness.

2 Hypotheses

Hypothesis 1 (socioeconomic resources): Children of teenage parents whose households have more socioeconomic resources will be more likely to have high levels of school readiness and less likely to have low levels.

Hypothesis 2 (maternal characteristics): Children of teenage parents whose mothers are working, enrolled in school, have better mental health, and were at least 18 at the child's birth will be more likely to have high levels of school readiness and less likely to have low levels.

Hypothesis 3 (parenting): Children experiencing higher-quality parenting and home environments will be more likely to have high levels of school readiness and less likely to have low levels.

Hypothesis 4 (parental relationships): Children of teenage parents whose mothers' intimate relationships are more stable and happier will be more likely to have high levels of school readiness and less likely to have low levels.

Hypothesis 5 (exposure to adults): Children living with more adults and fewer other children and those in nonparental child care are expected to interact more with adult caregivers and will therefore be more likely to have high levels of school readiness and less likely to have low levels.

3 Method

3.1 Data

The Early Childhood Longitudinal Study-Birth Cohort (ECLS-B) selected a nationally representative sample of about 10,700 children born in 2001, following them from infancy through the start of kindergarten (U.S. Department of Education, 2007). It is the first U.S. nationally representative survey to track children throughout this period of early life using parent interviews and direct child assessments. The ECLS-B also includes a large subsample of children with teenage mothers and fathers compared to many other datasets. The sample was drawn from births registered in the National Center for Health Statistics vital statistics system based on a clustered, list frame sampling design. Children were sampled from 96 core primary sampling units, which were counties and county groups. Births to mothers younger than 15 were excluded for reasons of confidentiality and sensitivity, so our findings are not representative of children of this small but vulnerable group

of teenage mothers (the birth rate for ages 10-14 was 0.6 births per 1,000 teens in 2008, compared to 41.5 for ages 15-19; Hamilton, et al., 2010).

This study uses data from the first three waves of the survey, conducted when the children were about 9, 24, and 52 months old. The primary parent, who almost always was the biological mother, was interviewed in person. The weighted response rates for the parent interview were 74%, 93%, and 91% for Waves 1, 2, and 3. Stata software accounted for complex survey design using replication weights that made findings representative of U.S. children born in 2001. The primary analysis sample for this study was restricted to children who had at least one parent under age 20 at their birth, whose biological mothers participated in the interview at all three waves, and who completed assessments at all three waves including the preschool math and literacy assessments, resulting in about 850 eligible cases. After listwise deletion of missing data for all except for two background variables that retain missing data indicators for analysis, our main analysis sample was about 800 cases.[2] Additional analyses only conducted for specific hypotheses were restricted to: (1) cases that included direct parent assessments at Waves 2 and 3, resulting in a sample of about 550 children, (2) children whose mothers answered the mental health questions in the separate self-administered questionnaire (N≈700), and (3) children whose mothers answered the questionnaire and were married or cohabiting at Waves 2 and 3 (N≈300).

3.2 Measures

3.2.1 Child preschool outcomes. The indicators of high and low levels of school readiness were constructed from four measures of health and development at Wave 3 (about age 4½), drawn from in-person child assessments and parent interviews (see Snow et al., 2007 for more information). All coding decisions were ours except as indicated below. Table 1 presents descriptive information for all variables. Two of these measures reflect direct assessments. Children's *reading scores* were calculated by ECLS-B based on a 35-item test covering areas appropriate for pre-kindergarten learning such as phonological awareness, letter sound knowledge, letter recognition, print conventions, and word recognition. *Math scores* were calculated by ECLS-B using a two-stage assessment routed after the first stage depending on the child's score, involving number sense, counting, operations, geometry, pattern understanding, and measurement. Parent reports were the source of the two other measures. Children's *behavior* was represented by a standardized continuous variable, averaged from 24 items in which the parent was asked how frequently the child exhibited specific behaviors, using a 5-point scale ranging from "never" to "very often" (Cronbach's alpha=0.86). These items came from the Preschool and Kindergarten Behavior Scales—Second Edition, the Social Skills Rating System, and the Family and Child Experiences Study, and also included questions developed for the ECLS-B. For example, parents were asked how often the child shares belongings or volunteers to help other children, how often the child is physically aggressive or acts impulsively, and how well the child pays attention. *Child health status* was reported by the mother as excellent, very good, good, fair, or poor. Unweighted correlations among the child outcome measures varied in strength, but math and reading most strongly correlated with each other (at 0.72) and behavior and health most strongly correlated with each other (at 0.22).

INSERT TABLE 1 ABOUT HERE

Like others, we conceive of school readiness as a continuous phenomenon, but for clarity in discussing findings we henceforth refer to children with high levels of readiness as "ready" and those with low levels of readiness as "unready." Children were coded as "ready" (19% of teenage

[2] Because of ECLS-B confidentiality requirements, all Ns are rounded to the nearest 50. We compared eligible children with math scores, but who were listwise deleted for other non-response, to the analysis sample. Eligible children who were listwise deleted had mothers with 0.5 years lower education at Wave 1 than those in the analysis sample ($p<.01$), but they did not differ significantly by maternal age or household poverty.

parents' children), "unready" (21%), or neither (60%) on the basis of their scores in these four developmental domains. To be labeled as "ready," children had to evidence typical development or better in each domain compared to all same-age peers: Their health needed to be reported as excellent or very good (which was true for 81% of the sample, and which we considered a necessary condition for readiness to learn), and they needed to score higher than 0.25 standard deviations below the overall mean for the population of children born in 2001 on all three domains of behavior, math, and reading.[3] Conversely, children labeled as "unready" relative to their peers were in fair or poor health or scored at least 0.5 standard deviations below the overall mean for children born in 2001 on all three domains of behavior, math, and reading. Although our cutoffs for high and low levels of school readiness were necessarily subjectively defined, we consider them useful cut points in the continuum of school readiness because they represent positive or negative outcomes, respectively, across four key domains of child development. About 60% of the sample was coded as neither particularly "ready" nor "unready" for school.

3.2.2 Socioeconomic resources. All independent variables in this study were measured at Wave 1 (about 9 months old) except where indicated, with a measure from Wave 3 (about 4½ years old) also used in creating measures of change between waves. Our indicator of a household income below the *poverty* line was calculated by ECLS-B using federal poverty guidelines, which account for household size and income. In some cases, household income was imputed by ECLS-B using hot deck imputation. *Maternal education* was based on an ECLS-B constructed variable, with highest degrees recoded into approximate years and logical adjustments made to correct inconsistencies across waves. Household *food security* was constructed by ECLS-B, comparing food secure to food insecure households, in which a lack of money affected food quality or availability. A final variable summed a household's *assets*, measured as home and car ownership, a bank account, and money in stocks or mutual funds.

3.2.3 Maternal characteristics. Four variables measured characteristics of the child's mother. An indicator was scored as 1 if the mother was *under 18* at the child's birth and 0 otherwise. Mothers' *paid work* and *school enrollment* were captured by ECLS-B constructed dichotomous variables for none versus any. Finally, mothers' *depressive symptoms* were measured using the available subset of questions from the Center for Epidemiologic Studies-Distress Scale (CES-D; Radloff, 1977). Mothers reported the frequency of experiencing specific symptoms in the last week, ranging from never or rarely to most or all of the time (Cronbach's alpha=0.87 for Wave 1).

3.2.4 Parenting measures. Four measures captured aspects of the parent-child relationship, with the first measure for each from Wave 2 (age 2). Counts of positive and negative factors in children's *home environments* included 21 items at Wave 2 and 12 at Wave 3, ranging from the presence of books in the household, to a consistent bedtime routine, to playing together. *Interviewer-observed parenting behaviors* during the assessment counted mothers' display of behaviors such as smacking, kissing/hugging, ensuring a safe play environment, responding verbally to the child, and interfering with the child's actions. Eight items were coded as 0 for "negative" and 1 for "positive" parenting behaviors and averaged. This measure was not available at Wave 3. The *Two Bags Task*, a modification of the Three Bags Task used in prior research (Love *et al.*, 2002), was a videotaped problem-solving task in which parent and child played for 10 minutes with a set of dishes and a picture book. We use coders' rating of the parent's emotional supportiveness (constructed by ECLS-B), ranging from 1 to 7 at Waves 2 and 3 (Nord, Edwards, Andreassen, Green, & Wallner-Allen, 2006). The *Toddler Attachment Sort – 45*, which modified the Attachment Q-Sort (Nord et al., 2006)

[3] Ideally, our "ready" cutoff would have been at or above the mean in each of the three domains, but the small number of children of teen parents in this sample who met this more stringent cutoff did not permit extensive multivariate analysis.

and was only conducted at Wave 2, assessed the child's attachment to the mother. Interviewers scored the child on behaviors such as "seeks and enjoys being hugged" and "shows no fear, into everything." The child's attachment relationship was coded by ECLS-B and dichotomized as secure or not.

3.2.5 Mother's marriage/cohabiting relationship quality. For all children in the sample, the number of *partner transitions* experienced by the mother between Waves 1 and 3 was calculated. Based on partners/spouses listed in the household roster at the time of each wave, this variable ranged from 0 to 3. The other measures were limited to children whose mothers completed the Waves 2 and 3 self-administered questionnaire and who were married or cohabiting. An *argument index* was created as the average of mothers' reports that they and their coresident partner/spouse often, sometimes, hardly ever, or never argued about 10 topics such as children, sex, and chores. A measure of *positive relationship interaction*, available only at Wave 2, was calculated from mothers' reports about how frequently (ranging from less than once a month to almost every day) they and their coresident partner/spouse talked about their days or their interests, laughed together, and calmly discussed things, worked together on a project. Mothers' *relationship satisfaction* with spouse or coresident partner was coded as 1 for "very happy" and 0 for "fairly happy" or "not too happy."

3.2.6 Exposure to adults. Several variables from Waves 1 and 3 measured the presence of adult caregivers, as well as other children who might reduce the amount of attention received from adults. The *biological father*'s coresidence with the child was included by ECLS-B as a dichotomous variable. Dichotomous variables constructed by ECLS-B indicated whether any *grandparent* or any *other adult*, excluding parents or their partners, lived in the household. A measure captured the number of coresident adults who were not reported to be contributing to the household's income. Another ECLS-B constructed variable counted the number of coresident *children* under age 18 besides the study child. Finally, a dichotomous variable constructed by ECLS-B measured whether the study child received any nonparental *child care*.

3.2.7. Control variables. Demographic controls in this study's multivariate analyses included the child's centered age in months at the Wave 3 assessment (which is necessary for correctly analyzing the age-sensitive raw scores for math and reading), gender, and race/ethnicity (constructed by ECLS-B and coded as Latino, non-Latino White, non-Latino African American, and other/multiracial), the mother's marital status at birth (obtained from the birth certificate and coded as married versus other), and the father's age at birth (<20 years versus older). The ECLS-B survey also included maternal background factors that have been found to influence both selection into teenage childbearing and its consequences (Oxford & Spieker, 2006; SmithBattle, 2007): whether the mother's household received welfare assistance between ages 5 and 16 (including an indicator for missing data), whether she lived with both parents until age 16, and her mother's education (less than a high school diploma, a high school degree, or higher, including an indicator for missing data).

4 Results

4.1 Descriptive Analyses

All analyses in the study were weighted to represent children born in the United States in 2001. Although the goal of this study was to analyze high and low levels of school readiness among children of teenage parents, supplemental analyses compared these children to peers born in the same year, revealing cause for concern about the school readiness of teen parents' children. 31% of children born to parents who were not teenagers met our "readiness" criteria, compared to 19% of children of teenage parents. Differences in unreadiness were even starker: 12% of children who did not have a teen parent were labeled as "unready" using our criteria, but 21% of teenage parents' children fell into this category. All remaining analyses focus solely on children of teenage parents.

Table 1 also reports significant differences between "ready" and "unready" children of teenage parents for the hypothesized factors, as well as control variables and child outcomes. Marginally significant ($p<.10$) findings are presented for readers' reference but are not discussed in the text. Over half of the hypothesized relationships were significant in the expected direction, including variables representing each of the five hypothesized domains. For example, "ready" children had mothers with 12 years of education at Wave 1 (about 9 months old), compared to 10½ years for mothers of "unready" children. In another example, 72% of ready children received nonparental child care at 9 months, but 49% of unready children did. Perhaps surprisingly, mothers' school and work status and the presence of the biological father, grandparents, or other adults were not significantly related to readiness or unreadiness for teenage parents' children. One interesting relationship among the control variables is worth noting: 57% of ready children of teen parents were girls, and 65% of unready children were boys.

4.2 Multivariate Analyses

Binary logistic regression models, reported in Table 2, analyzed the associations between the hypothesized factors and first readiness, then unreadiness, each compared to all other children of teen parents. These models tested the hypothesized domains one at a time by adding the relevant factors to a baseline model containing control variables and maternal age. For each factor, Model 1 presents estimates for hypothesized measures from Wave 1 (if the domain had available measures then) or Wave 2, and Model 2 introduces Wave 3 estimates and change between waves. It is important to note that most of the significant relationships were quite sizeable in magnitude, suggesting that many variables we focused on are important for understanding children's outcomes. This conclusion is further bolstered by the high percentage of correctly predicted outcomes in the Table 2 models (not shown), which ranged from 80.6% to 84.5% for readiness and 77.4% to 83.3% for unreadiness depending on the domain being tested.

TABLE 2 HERE

Three of the four socioeconomic resource variables addressed in *Hypothesis 1* were associated with at least one of the outcomes as predicted. The odds of being labeled "ready" for the transition to school were twice as high for nonpoor children as for children whose household incomes were below the *poverty* line in infancy. The introduction of change over time in Model 2 revealed that chronic poverty was responsible for this relationship: Children who were not poor at Waves 1 or 3 had 3 times higher odds of being ready than those who were poor at both waves. Counterintuitively, children who ever experienced poverty had significantly *lower* odds of being unready for school than those who were never poor, suggesting a curvilinear relationship. This finding is particularly surprising given the bivariate analysis displayed in Table 1, which shows that fully 52% of "unready" children were living in poverty in infancy.[4] A one-year increase in *maternal education* in infancy was associated with 51% higher odds of being ready and 30% lower odds of being unready. These relationships persisted when change over time was included in the model, and each year of additional maternal education by Wave 3 was associated with a 43% increase in a child's odds of readiness. Household *food security* in infancy was not significantly related to readiness or unreadiness, but a model incorporating change over time revealed that household food insecurity at age 4½, regardless of status at Wave 1, was associated with a fourfold to fivefold increase in a child's odds of unreadiness compared to being food secure at both waves. Finally, each additional *household asset* at

[4] In supplementary bivariate analyses, children who stayed in poverty at both waves were more likely to be unready for school compared to children who were poor at just one wave or neither. In multivariate analyses including only controls and poverty measures, being poor at either Wave 1 or 3 was associated with lower odds of unreadiness compared to never being poor, but staying poor was not significant. After adding the other socioeconomic measures, a significant negative association between chronic poverty and unreadiness emerged compared to never being poor.

Wave 1 predicted a 30% decrease in the odds of being unready for school. Change in assets over time did not predict readiness or unreadiness.

Hypothesis 2 expected *maternal characteristics* to be related to children's school readiness and unreadiness. As hypothesized, having a mother who was *younger than 18* at birth compared to 18 or older reduced a child's odds of readiness by more than half and nearly tripled his odds of being unready for school. Mothers' *work* and *school* status were not related to readiness or unreadiness, with one exception: Children whose mothers worked for pay at Waves 1 and 3 had 58% lower odds of being labeled "unready" than those whose mothers did not work at either wave. Finally, mothers' *depressive symptoms* were important predictors. A one-unit increase in depressive symptoms on a scale from 0 to 36 was associated with a 6% decrease in a child's odds of readiness and an 8% increase in the odds of unreadiness. Introducing change over time further showed that each one-unit increase in maternal depression from infancy to preschool was associated with 7% higher odds of unreadiness for school.

Hypothesis 3 expected *parenting quality* to predict children's readiness and unreadiness for school, and only the measure of *interviewer-observed parenting behaviors* was not related to these outcomes as expected. A more enriching *home environment* at age 2 was not associated with child outcomes, but an improved home environment by age 4½ was negatively related to children's odds of being labeled "unready." A one-unit increase in parents' *emotional supportiveness*, as observed in the Two Bags Task at age 2, was associated with 65% higher odds of school readiness, but change in this measure was not significant. Being *securely attached* to the primary parent at age 2 predicted a reduction by half in a child's odds of being unready for school.

Hypothesis 4, which expected *mother-partner relationship quality* to be related to child outcomes, was the only one not to receive substantial support from multivariate analyses. None of the hypothesized factors was significantly related to readiness or unreadiness at the $p<.05$ level. This appears in part to be a result of sample size, which was smaller because only mothers who were cohabiting or married at both Waves 2 and 3 could be included in the relationship analyses. Some of the coefficient sizes were similar to those reported for significant relationships elsewhere in the table, but the smaller sample size reduced statistical power.

Hypothesis 5 stated that children's *exposure to adults* should be related to their school readiness and unreadiness. The *biological father's coresidence* at 9 months old did not predict either outcome, but having the father in the household at age 4½, regardless of his earlier coresidence, was associated with a 57% to 76% (depending on his coresidence in infancy) decrease in the odds of unreadiness compared to not living with him at either wave. Conversely, *grandparent coresidence* mattered in infancy rather than later, and in an unexpected direction: Living with at least one grandparent at 9 months but not at 4½ predicted a 61% decrease in the odds of school readiness compared to never living with grandparents. *Other adults*' persistent coresidence at Waves 1 and 3 was associated with an 85% decrease in children's odds of being ready for school compared to never living with other adults. The number of *coresident adults contributing* to the household income was not related to readiness or unreadiness. As expected, the presence of *additional children* in the household predicted more negative outcomes. Model 2 revealed that each additional child in the household in infancy was associated with a 41% decrease in the odds of school readiness, and each additional child by age 4½ predicted another 37% decrease in the odds of being ready. Finally, *nonparental child care* in infancy was associated with doubled odds of being ready for school at age 4½, and halved odds of being unready. Models incorporating child care status over time showed that receiving nonparental child care at both Waves 1 and 3 predicted nearly tripled odds of being ready for school compared to receiving no nonparental care at either wave.

Supplementary analyses based on Model 2 in Table 2 combined each of the significant factors for each outcome into the same model. These analyses, which include many variables, are not

reported in tables because of the limited statistical power available in the sample. In these regressions, socioeconomic factors emerged as the most consistently significant predictors for each outcome. When predicting readiness, three of the five significant factors were socioeconomic: poverty, maternal education, and food insecurity. The other two significant factors were home environment change and depressive symptoms in infancy. More factors remained significant in the combined model of unreadiness. As in Model 2, household poverty was not positively related to unreadiness as expected, but instead had a negative association. Factors from four domains were associated with unreadiness as hypothesized: maternal education, household assets, and food insecurity in the socioeconomic domain, and paternal coresidence, secure attachment to the primary parent, and improvement in home environment.

The importance of the factors we have identified for understanding a child's school readiness and unreadiness can be illustrated using two supplemental statistical strategies: predicted probabilities and correctly predicted outcomes. We address each in turn. Using estimates from Model 2 from Table 2 and Stata statistical software, predicted probabilities reported in Figure 1 compared hypothetical children who had average (for continuous variables) or modal (for categorical variables) values for the sample of teenage parents' children on all variables except those we manipulated. We then manipulated all variables that were significant predictors of readiness and/or unreadiness, analyzing one domain at a time. For the manipulations, we chose a "low" value (e.g., one associated with less favorable child outcomes; for the poverty variable, which had opposing relationships to readiness and unreadiness, we coded chronic poverty as low) and a "high" value, making sure both values fell well within the range of observed values in the sample. For example, for maternal education the "low" values were 10 years at Wave 1 and no education gain by Wave 3 (about four years later), and the "high" values were 12 years and 2 years of education gain. See the notes in Figure 1 for details. We excluded the analysis of parental relationship factors (Hypothesis 4) because of their lack of significance in multivariate models.

FIGURE 1 HERE

An additional strategy when assessing the importance of the variables in these models for predicting school readiness and unreadiness among teen parents' children is the comparison of children's actual outcomes to the probabilities for each case predicted by the models in Table 2, which were rounded up or down to 0 or 1. As described above, more than three quarters of cases were correctly predicted in each domain's model (including the parental relationship domain, further bolstering the speculation that small sample size might be behind the lack of significant relationships). The maternal characteristics measures best predicted readiness compared to the other three significant domains, with 84.5% of cases correctly predicted. The socioeconomic and adult exposure domains were close behind, with 83.5% of cases correctly predicted. For unreadiness, the socioeconomic domain most accurately predicted outcomes at 79.7%, with the parenting and adult exposure domains in second place at 78.3%.

At least three important conclusions can be drawn from these two statistical strategies' findings. First, our models often strongly predicted a child's odds of readiness or unreadiness, suggesting that we successfully modeled factors that make some children ready for school and others not. For example, the hypothetical child with "low" values on socioeconomic resources had an 88% likelihood of being unready, and a child with "high" values on other adult care had a 46% likelihood of being ready for school. The comparison of actual versus predicted outcomes shows that the identified factors predicted both school readiness and unreadiness well, even though different domains were the strongest predictors of each. Second, the large differences in children's predicted probabilities of readiness versus not and unreadiness versus not based on the significant factors identified in our models suggest that each of the four domains includes important policy levers for improving the outcomes of teenage parents' children. For example, a hypothetical child with "high"

socioeconomic resource values had a twenty-fold higher likelihood of being ready for school compared to a child with "low" values. Third, different domains had different levels of importance for predicting readiness versus unreadiness at age 4½. Maternal characteristics were the most accurate predictors of children's actual readiness, while socioeconomic resources best predicted unreadiness. Another way to look at the issue of various domains' importance is to see which domains gave children extremely low chances of being ready or unready in Figure 1. From this perspective, socioeconomic resources and care by adults were each particularly important for predicting school readiness: Without a basic level of protective factors from these domains, children have almost no chance of showing school readiness at age 4½ (2% and 0.005%, respectively). Conversely, with reasonably high-quality parenting and with the right kind of exposure to adults, children had very low chances of being unready for school (16% and 14%, respectively).

5 Discussion

The goal of this study was to identify structural and proximate factors associated with high and low levels of school readiness among children of teenage parents in the United States. We measured readiness using a multidimensional conceptualization that was based on health and cognitive and behavioral development just prior to the start of kindergarten. Grounded in the School Transition Model and in the characteristics and experiences of this unique population, our hypotheses suggested that the domains of socioeconomic resources, maternal characteristics such as age and depressive symptoms, parenting quality, parental relationship characteristics, and exposure to adults should all be associated with children's school readiness. About one fifth of teenage parents' children displayed solid school readiness at age 4½: They were above or near the overall sample's mean on each developmental outcome. Another fifth of the sample clearly evidenced low readiness relative to peers, as evidenced by problematic health or scores well below the overall mean on reading, math, and behavior. Four of the five hypothesized domains of factors identified in this study predicted high and/or low readiness. Only parental relationship quality was not significantly associated with either high or low readiness, perhaps because of the small subsample. Poverty had a surprising curvilinear relationship to school readiness, with households below the poverty line experiencing lower odds of both high and low readiness compared to others. Despite this finding, when all domains were combined, socioeconomic factors emerged as particularly important for understanding high and low school readiness.

Besides the multidimensional conceptualization of school readiness relative to a national sample of peers, this study contributed to the measurement of school readiness in two additional ways. First, we found that the assumption made in regression models—that the relationship between independent and dependent variables is the same at high and low levels of the dependent variable—was not supported among teenage parents' children for the domains of school readiness we examined. Of the hypothesized factors that significantly predicted high and/or low school readiness, the majority did not predict high and low readiness significantly in the same direction. Future research on other populations should consider that low and high levels of school readiness may have distinct relationships with their predictors, so it may be worthwhile to explore alternatives to regression models. Second, modeling the hypothesized factors at multiple time points during early childhood and including change over time undoubtedly improved our understanding of school readiness among teen parents' children. For example, consistent child care at both waves was strongly associated with children's high levels of readiness, but child care at either single time point was not. In another example, having other children in the household during infancy negatively predicted children's high levels of readiness, but the introduction of additional children into the household over the following three years was even more negatively associated with high levels of

readiness. Modeling the dynamics of predictors of school readiness throughout early childhood is a promising strategy for future research in the area.

Several limitations should be addressed in future research. First, it would be useful to understand the processes through which social structural and interpersonal factors are related to the health and cognitive and behavioral development of teenage parents' children, including potential mediating and moderating relationships among these factors. Substantial literature suggests that social structure and context function in concert with child characteristics and abilities to develop readiness for school (Meisels, 1999; Piotrkowski, 2004; Rimm-Kaufman & Pianta, 2000), and further examination into the complexity of these interactions is needed to refine our understanding of how the processes shape early development. Our ongoing quantitative and qualitative research is working to address aspects of this question. Second, confidentiality restrictions precluded an investigation of children with mothers younger than 15, who are an extremely small (Hamilton et al., 2010) but interesting population. Third, including less subjective measures of behavior and health in addition to parent reports would be an improvement. Because most health measures in the ECLS-B study were contingent on diagnosis by a medical professional, they conflated health status with access to health care. Therefore, we relied on parent reports. Finally, our data are longitudinal but cannot firmly establish causality. For example, the nonrandom selection of teenagers into parenthood affects children's development (Levine et al., 2001; Turley, 2003), and the available background variables allow us to control for many, but not all, important selection factors. Randomized interventions are needed to assess the effectiveness of the factors identified here for improving the school readiness of teenage parents' children.

Although this study's longitudinal observational data cannot establish causal relationships, we identified many strong associations between children's situations in their first two years of life and their development and health two to four years later. In most cases, the findings made theoretical sense, and they often supported existing policy interventions that may have the potential to keep some children of teenage parents from having problematically low school readiness and spur others to perform quite highly. Several factors appear to be particularly promising because they significantly (including $p<.10$) predicted both outcomes in such a way that improving each factor may be able to simultaneously reduce low levels of readiness and promote high levels among children of teenage parents. These include maternal education and gains in education in the socioeconomic domain, maternal age of at least 18 and fewer depressive symptoms at 9 months postpartum in the maternal characteristics domain, the socioemotional side of parenting (emotional supportiveness or secure attachment) and gains in home environment quality in the parenting domain, and having fewer children in the household and receiving nonparental child care in infancy in the domain of exposure to other adults.

Based on these core factors identified in the study, we make three preliminary policy recommendations that could be further developed using randomized interventions in the U.S. context. First, the associations between gains in maternal education and children's enrollment in nonparental child care and children's high and low school readiness lend further support to evidence from intervention programs, which finds that children benefit when teenage mothers attend school while their children attend onsite child care centers with qualified staff (see Clewell, Brooks-Gunn, & Benasich, 1989 for a review). Because research has suggested that enrollment in these programs reduces repeat teenage births (Sadler et al., 2007; Williams & Sadler, 2001), another core factor benefiting children may also be addressed simultaneously. Popular concerns that a mother should be home with her child, instead of attending school and using child care, were not borne out by this study. Second, the relative lack of readiness experienced by children of very young teenage mothers and those with less education may have implications for teenage pregnancy prevention programs. Targeting pregnancy prevention among school-age girls who have not yet attained a high school

diploma, while providing teens who do become pregnant with basic levels of socioeconomic support and investments in mental health and high-quality home environments and parenting, could yield positive results for children. Third, both structural factors and interpersonal relationships with parents and other adults were significantly related to school readiness among teenage parents' children. Our findings suggest that successful policies aimed at teenage parents and their children should consider both family processes and structural influences.

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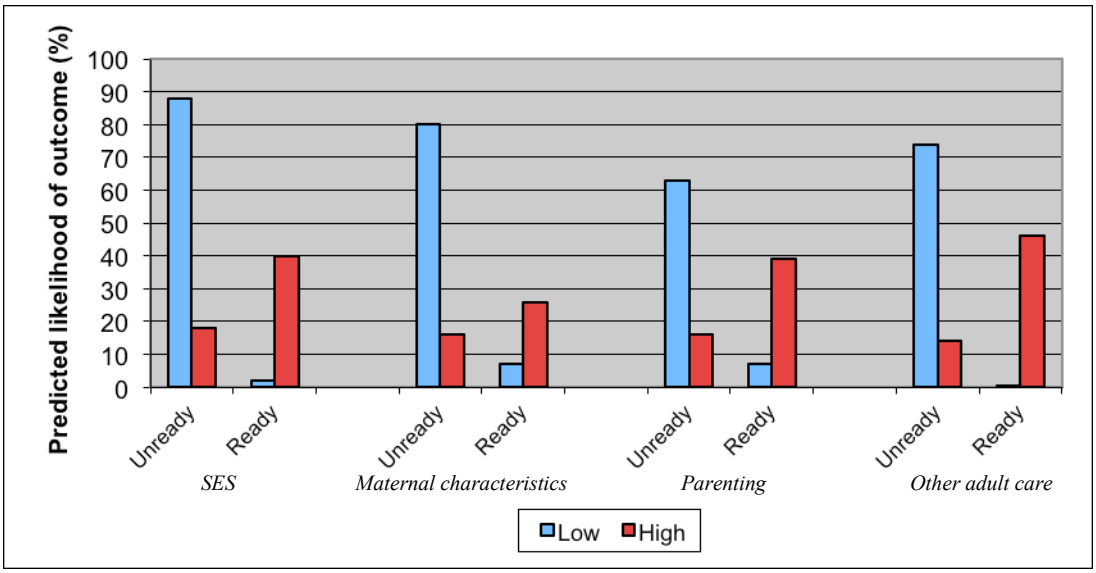
Figure 1
Predicted likelihoods of school readiness and unreadiness for teen parents' children.



Notes: Source: Early Childhood Longitudinal Study-Birth Cohort, 2001-2005. Rounded Ns: 550 for parenting measures, 700 for depression, 800 for all other measures. Predictions use estimates from Table 2 for each domain. Analyses account for sample design effects. For the SES domain, the "low" hypothetical child's household is in poverty and food insecure at Waves 1 and 3, household has no assets at Wave 1 with no change by Wave 3, and mother's Wave 1 education=10 years with no change by Wave 3. The "high" hypothetical child's household is not in poverty and not food insecure at Waves 1 or 3, household has 3 assets at Wave 1 with no change by Wave 3, and mother's education is 12 years at Wave 1 with an increase of 2 years by Wave 3. For maternal characteristics, "low"=mother aged 15-17, not working at Waves 1 or 3, Wave 1 depression score of 10 with an increase of 3 by Wave 3; "high"=mother aged 18-19, working at Waves 1 and 3, Wave 1 depression score of 3 with a decrease of 3 by Wave 3. For parenting, "low"=not securely attached, Two Bags supportive parenting score of 3 with a change of -1 by Wave 3, home environment change of -0.1 by Wave 3; "high"=securely attached, Two Bags supportive parenting score of 4 with a change of 1 by Wave 3, home environment change of 0.1 by Wave 3. For other adult care, "low"=father not in household at Waves 1 or 3, grandparent in household at Wave 1 but not 3, other adult in household at Waves 1 and 3, 1 additional child in household at Wave 1 and 2 at Wave 3, not in child care at Wave 1 or 3; "high"=father in household at Waves 1 and 3, no grandparents, other adults, or additional children in household at Waves 1 or 3, in nonparental child care at Waves 1 and 3. All other variables are set to weighted means/modes for the subsample of teenage parents' children.

Table 1
Weighted means for children of teenage mothers, by school readiness level.

Variable (Wave 1 unless noted)	*All*	*Ready*	*Sig.*	*Unready*
Controls				
Child race/ethnicity				
Non-Hispanic White	0.39	0.49	*	0.32
Non-Hispanic Black	0.24	0.22		0.25
Hispanic	0.33	0.20	**	0.38
Other race	0.05	0.09	†	0.35
Child female[a]	0.49	0.57	**	0.35
Father's age >20[a]	0.37	0.41		0.36
Biological parents married at birth[a]	0.23	0.18		0.18
Mother ever on welfare age 5-16[a]	0.19	0.15	†	0.24
Mother lived with parents until age 16[a]	0.42	0.39		0.39
Grandmother's education < high school[a]	0.42	0.31	***	0.61
Hypothesis 1: SES resources				
Household income under poverty line[a]	0.50	0.33	*	0.52
Mother's education (8-20 years)	11.17	11.95	***	10.46
Food-insecure household[a]	0.16	0.18		0.21
Household assets count (0-4)	1.63	1.80	***	1.33
Hypothesis 2: Maternal characteristics				
Maternal age 15-17[a]	0.27	0.17	***	0.45
Mother not working[a]	0.40	0.39		0.44
Mother not in school[a]	0.73	0.75		0.73
Mother's depressive symptoms (0-36)	6.20	5.15	**	8.08
Hypothesis 3: Parenting quality				
Wave 2 home environment scale (0-1)	0.53	0.55	*	0.49
Wave 2 observed positive parenting behavior index (0-1)	0.91	0.94	*	0.88
Two Bags supportive parenting score (1-7)	4.06	4.36	***	3.87
Child securely attached to parent[a]	0.59	0.69	**	0.41
Hypothesis 4: Parental relationships				
Wave 1-3 partner transitions (0-3)	0.50	0.60		0.45
Wave 2 spouse/partner argument index (0-3)	0.86	0.74	*	1.11
Wave 2 mother's positive spouse/partner interactions (0-3)	2.51	2.68	**	2.25
Wave 2 mother's relationship less happy[a]	0.23	0.24		0.44
Hypothesis 5: Care by other adults				
Biological father in household[a]	0.51	0.54		0.43
Any grandparents in household[a]	0.45	0.39		0.50
Any other adults in household[a]	0.25	0.16		0.26
# adults not contributing to income (0-8)	0.66	0.57		0.60
# people under age 18 in household (1-11)	2.00	1.61	***	2.45
In nonparental child care[a]	0.43	0.28	**	0.51
Child outcomes at age 4½ (Wave 3)				
Ready for school	0.19	N/A		N/A
Unready for school	0.21	N/A		N/A
Preschool math theta score (-2.8 to 1.3)	-0.74	0.13	***	-1.32
Preschool reading theta score -2.4 to 1.2)	-0.78	0.05	***	-1.30
Parent-reported behavior score (standardized)	0.11	0.81	***	-1.01
Child's general health, parent-reported				
Poor/fair/good	0.19	0	N/A	0.44
Very good	0.36	0.38		0.33
Excellent	0.45	0.62	***	0.23

Notes: Source: Early Childhood Longitudinal Study-Birth Cohort, 2001-2005.
Analyses account for sample design effects. † p<.10 * p<.05 ** p<.01 *** p<.001; two-tailed design-based F tests [a] 1=yes
Rounded Ns: 800 for most measures, 550 for parenting measures, 700 for depression, 300 for mother's relationship measures.

Table 2
Odds ratios from logistic regression models predicting school readiness and unreadiness at age 4½.

Variable	Ready		Unready	
	Model 1: Wave 1/2	Model 2: Change	Model 1: Wave 1/2	Model 2: Change
Baseline model, Wave 1				
Age at Wave 3 assessment (months)	1.13 ***		0.91 **	
Child's race/ethnicity (White)				
African American	0.71		0.93	
Latino	0.44 *		1.14	
Other/multiracial	2.05 †		1.14	
Female child[1]	1.26		0.52 **	
Teenage father[1]	1.31		0.72	
Biological parents married at birth[1]	0.60		0.61	
Mother received welfare in childhood[1]	0.70		1.43	
Welfare history missing[1]	0.04 **		2.48	
Mother lived with parents until age 16[1]	0.83		1.01	
Grandmother's education (>HS degree)				
< high school degree	0.59		3.46 ***	
High school degree	0.97		1.11	
Missing information	0.30 †		2.44 †	
Hypothesis 1: SES resources				
Household under poverty line W1[1]	0.51 *		0.59 †	
Poor Waves 1 and 3[2]		0.31 *		0.35 **
Not poor W1, poor W3[2]		0.71		0.21 ***
Poor W1, not poor W3[2]		0.68		0.19 ***
Mother's education (years) W1	1.51 ***	1.68 ***	0.70 ***	0.64 ***
Change in education W1-3		1.43 **		0.79 †
Food insecure household W1[1]	1.62		0.73	
Insecure Waves 1 and 3[2]		0.89		5.47 ***
Not insecure W1, insecure W3[2]		0.74		4.18 ***
Insecure W1, not insecure W3[2]		1.93 †		0.86
Household assets count W1	0.96	1.08	0.70 *	0.61 *
Change in assets W1-3		1.30		0.77
Hypothesis 2: Maternal characteristics				
Young maternal age[a]	0.45 *	0.39 **	2.72 ***	2.59 ***
Mother not working W1[1]	1.42		1.38	
Working Waves 1 and 3[2]		0.95		0.42 *
Not working W1, working W3[2]		0.94		0.89
Working W1, not working W3[2]		1.72		0.47 †
Mother not in school W1[1]	1.45		0.93	
In school Waves 1 and 3[2]		0.65		1.25
Not in school W1, in school W3[2]		1.01		1.22
In school W1, not in school W3[2]		0.80		1.63
Mother's W1 depressive symptoms	0.94 *	0.93 †	1.08 ***	1.13 ***
Change in depression W1-3		0.98		1.07 *
Hypothesis 3: Parenting quality				
Home environment scale W2	0.42	0.73	0.54	0.23
Change in home environment W2-3		7.92 †		0.04 *
Interviewer-observed parenting W2	7.10	10.07	0.58	0.35
Two Bags supportive parenting score W2	1.65 *	2.12 **	0.87	0.70
Change in Two Bags W2-3		1.38 †		0.76
Secure child-parent attachment W2[1]	1.42	1.38	0.48 *	0.52 *
Hypothesis 4: Parental relationships				
Partner transitions W1-3	0.73	0.69	1.01	1.05
Partner argument index W2	0.48 †	0.53	1.73 †	1.46
Change in argument index W2-3		0.95		1.07

Positive partner interaction index W2	2.83	2.92	0.66	0.75
Marriage/cohabitation less happy W2[1]	1.75		2.10	
Less happy Waves 2 and 3[2]		1.27		3.03
Less happy W2, not W3[2]		1.95		2.01
Not less happy W2, less happy W3[2]		0.58		1.77
Hypothesis 5: Care by other adults				
Biological father in household W1[1]	1.46		0.63	
Father in household Waves 1 and 3[2]		1.31		0.43 **
Not W1, in household W3[2]		1.49		0.24 **
In household W1, not W3[2]		1.34		0.61
Any grandparents W1[1]	1.07		1.19	
Grandparents in household W1 and 3[2]		0.79		0.95
Not W1, in household W3[2]		0.50		1.27
In household W1, not W3[2]		0.39 *		1.67
Any other adults W1[1]	0.69		1.09	
Other adults in household W1 and 3[2]		0.15 *		1.77
Not W1, in household W3[2]		1.67		0.45
In household W1, not W3[2]		0.76		0.79
# adults not contributing to income W1	1.25	1.31	0.81	0.96
Change in adults not contributing W1-3		0.97		1.27
# under 18 in HH W1	0.85	0.59 **	1.12	1.22 †
Change in # of children W1-3		0.63 **		1.08
In child care W1[1]	0.43 *		1.72 *	
In child care Waves 1 and 3[2]		2.94 *		0.52 †
Not in care W1, in care W3[2]		1.19		1.11
In care W1, not in care W3[2]		2.59		0.73

Notes: Source: Early Childhood Longitudinal Study-Birth Cohort, 2001-2005. N for baseline and hypotheses 1 and 5≈800. N for maternal characteristics≈700. N for parenting≈550. N for relationships≈300.
Odds ratios greater than one indicate a positive association with the outcome, and numbers below one a negative association.
All variables labeled "baseline model" report coefficients from a model including only these variables.
All variables labeled under hypotheses were added one hypothesis at a time to the baseline model.
Analyses account for sample design effects. † p<.10 * p<.05 ** p<.01 *** p<.001 two-tailed tests [1] yes [2] reference group is not at either wave [a] because it is a key demographic control, maternal age is part of the base model and included in all models summarized here