How Resource Dynamics Explain Accumulating Developmental Disparities for Teen Parents' Children*

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RUNNING HEAD: Resources and Teen Parents' Children

* This research is based on work supported by a grant from the National Science Foundation (SES 1061058). Research funds were also provided by the NIH/NICHD funded CU Population Center (R24HD066613). The authors thank Richard Jessor, Sarah Kendig, Joshua Goode, Nancy Mann, and Jeff Dennis for their contributions to this project. Direct correspondence to Stefanie Mollborn, Sociology and Institute of Behavioral Science, 483 UCB, Boulder, CO 80309-0483. E-mail: mollborn@colorado.edu.

Abstract

Using the nationally representative Early Childhood Longitudinal Study-Birth Cohort (2001 - 2007; N = 8600), we articulated several dynamic patterns in socioeconomic resources to account for growing developmental and health disparities throughout early childhood. Multilevel growth curve models examined the puzzle of disparities experienced by teen parents' children, whose outcomes increasingly lag those of peers while their parents are simultaneously experiencing socioeconomic improvements. Duration of socioeconomic resources is the strongest explanation for the puzzle, as persistently low income, maternal education, and assets fully or partially accounted for growth in cognitive, behavioral, and health disparities experienced by teen parents' children from infancy through kindergarten. Results suggest that policy interventions that consider the timing of low socioeconomic resources in a household, both in duration and relative to age, might reduce or eliminate disparities experienced by teen parents' young children.

Keywords: socioeconomic resources, resource dynamics, early childhood, teen parenthood, growth curve analysis

How Resource Dynamics Explain Accumulating Developmental Disparities for Teen Parents' Children

Americans have expressed increasing concern about income inequality and the perilous financial situation of less educated people in the recent economic downturn. In 2008, 71 percent of U.S. adults responded in a national poll that income inequality was a "serious" or "very serious" problem facing our society today (Democracy Corps/Campaign for America's Future 2008). In his September 2012 speech accepting the Democratic Party's presidential nomination, President Barack Obama identified early childhood education as an important approach for improving Americans' financial well-being. His strategy follows a growing emphasis among researchers on early childhood as an ideal time for policy interventions to improve people's conditions later in life (Duncan, Ludwig, and Magnuson 2007). Scholars have found that every dollar invested in early childhood education returns $8-14 in the long term (Duncan, Ludwig, and Magnuson 2007), in large part because early childhood conditions shape the rest of the life course.

The research and policy emphasis on early childhood education is motivated by evidence that developmental disparities by socioeconomic status, race/ethnicity, immigrant status, and other social characteristics emerge prior to the start of school (Entwisle, Alexander, and Olson 2004). Here, we consider the developmental disparity experienced by children born to teen parents, a status that has been linked to compromised school readiness in the year prior to formal school entry (author citation 2012). School readiness during the transition to school, in turn, very strongly predicts academic achievement throughout compulsory schooling and shapes socioeconomic outcomes in adulthood (Duncan et al. 2007; Duncan, Yeung, Brooks-Gunn, and Smith 1998). These insights, explored in the burgeoning literature on cumulative advantage and disadvantage (Case, Lubotsky, and Paxson 2002), have shifted the focus of policymakers and researchers alike toward the preschool years, aiming to give children a level playing field when they start the transition to school.

However, these research efforts have been hampered by a lack of nationally representative longitudinal data and child assessments from the preschool years. The Early Childhood Longitudinal Study-Birth Cohort (Snow et al. 2009), which tracked a nationally representative sample of U.S. children from birth in 2001 through the start of kindergarten, has addressed this gap by combining extensive surveys of multiple caregivers with multiple direct assessments of children and parents starting in infancy. These data now enable researchers to produce generalizable findings for the entire period of early childhood. This breakthrough coincides with theoretical developments in the study of social stratification and socioeconomic status (DiPrete and Eirich 2006). While past research tended to rely on simple measures of socioeconomic resources from a single point in time, newer work has begun to articulate and study the *dynamic and multidimensional nature of socioeconomic resources*. The experience of poverty differs greatly depending on its duration and on the other socioeconomic domains in which it is situated (Duncan, Brooks-Gunn, and Klebanov 1994). For example, a child who is identified as living in poverty at age 4 may have been poor all her life or only recently become poor. Or perhaps this child has highly educated parents who have low income because they are enrolled in school, but who have a financial "safety net" in the form of wealth or assets. These are examples of the resource dynamics that shape the experience and consequences of socioeconomic status.

Some researchers have worked to articulate and operationalize specific resource dynamics using data from different phases of the life course (Brooks-Gunn and Duncan 1997; Guo 1998). For example, Duncan and colleagues (1994) and the NICHD Early Child Care Research Network (2005) found that persistent (as opposed to transient) poverty was an important predictor of children's school readiness. Guo (1998) identified timing effects of poverty, with both childhood and adolescent poverty independently predicting adolescent academic achievement. Examining outcomes in young adulthood, Wagmiller and colleagues (2006) found both persistent poverty and the timing of poverty during childhood and adolescence to be consequential. Willson, Elder, and Shuey (2007) found that several domains of socioeconomic status, as well as persistent patterns in these domains over time, independently predicted health in later life.

Although considerable theoretical and empirical ground has been broken in the study of resource dynamics, questions remain. Some resource dynamics have been discussed in the literature but not fully articulated or operationalized in analyses. Newer analytic approaches for longitudinal data can address these shortcomings. There has also been a disproportionate focus on income and poverty in the literature, with much less attention to other important aspects of socioeconomic status such as education and wealth (see Duncan et al. 2002 and Willson et al. 2007 for exceptions). Researchers have documented both dynamic resource processes and the accumulation of advantage and disadvantage in children's development, but the former has not been brought to bear as a possible explanation for the latter. Our primary aim in this study was to integrate and measure a set of dynamic and multidimensional socioeconomic processes and to use them to understand how developmental disadvantage accumulates for marginalized groups in early childhood. Using a multilevel growth curve framework that analyzed children's developmental trajectories, we modeled time-dependent processes, nonlinearities, and overlapping resource domains. Reputable direct assessments in the nationally representative ECLS-B survey permitted us to consider a variety of developmentally appropriate longitudinal outcomes in the areas of cognition, behavior, and health. We were also able to incorporate an extensive set of controls to mitigate selection effects.

In integrating and modeling these complex resource dynamics, we focused on a specific type of social marginalization in U.S. society that has been linked to accumulating developmental disadvantage among children: the experience of having a teenage parent. With 10 percent of all births occurring to teen mothers in 2009 (Hamilton, Martin, and Ventura 2010) and more than 1 in every 6 teenage girls projected to become a mother before age 20 (Perper and Manlove 2009), teen childbearing is a widespread source of social disadvantage in the contemporary United States. It is also an inextricable part of the experience of socioeconomic marginalization: Analyses of the ECLS-B data have found that the majority of babies living in poverty have a teenage mother (author citation 2012). Similarly, the majority of babies whose mothers did not finish high school also have a teen mother (author citation 2012). For all of these reasons, teen parenthood is an interesting case for testing whether resource dynamics can explain the accumulation of developmental disadvantage throughout early childhood. It is particularly remarkable because of an important empirical puzzle inherent in past evidence about the consequences of teen childbearing, which we describe below.

THE PUZZLE OF THE CONSEQUENCES OF TEEN PARENTHOOD

We know a lot about the consequences of teen childbearing for mothers, fathers, and children. This knowledge has illuminated an intriguing puzzle that has yet to be solved. The puzzle starts with our understanding of the consequences of teen childbearing for young parents. In the years following a teen birth, the initially fairly severe socioeconomic consequences for young parents begin to moderate over time (Furstenberg 2007). For example, teen mothers' education is often disrupted in the short term, but in the years after the birth they typically make up some of that loss. Similarly, teen parents' initially compromised income and work status slowly become more similar over time to those of their childless peers. At midlife, teen parents lag behind peers from similar backgrounds in terms of occupational status, educational attainment, and health, but not income or work involvement (Henretta 2007; Taylor 2009).

Thus, we know that a young parent's socioeconomic situation improves as she moves through adulthood and her child grows. Meanwhile, what is happening to the teen parent's young child? Past research has shown that while the parent is slowly *gaining* socioeconomic ground, the child is rapidly *losing* substantial developmental ground compared to same-age peers from infancy through the start of school and beyond. Nationally representative data have shown that children of teen parents are disadvantaged at birth in terms of birth weight and preterm birth (Chen et al. 2007). Disparities in cognitive, behavioral, and health outcomes then increase from infancy to prekindergarten as teen parents' children lose ground compared to same-age peers (author citation 2012). Although some research has found that these disadvantages remain constant during the school years (Turley 2003), other scholars have found that teen parents' children continue to fall farther behind their peers from school entry throughout elementary school and adolescence (Brooks-Gunn and Furstenberg 1986).

WHY DO TEEN PARENTS' CHILDREN LOSE DEVELOPMENTAL GROUND?

Our analyses using nationally representative survey data confirmed the existence of the empirical puzzle: Resource gaps between teen-parent households and others stayed the same or decreased slightly across early childhood, while the children's own development and health worsened substantially over time relative to peers. Thus, we were left with a question: *Why do teen parents' children accumulate disadvantages in development and health?* Theories of intergenerational transmission of advantage, such as the concept of "linked lives" from the life course theoretical perspective, maintain that children's fates are directly linked to those of their parents. But in the case of teen-parent families, the situation is clearly not so straightforward. We turned to newer, dynamic ideas in the literatures on socioeconomic resources and the accumulation of disadvantage, many of them not yet fully tested empirically, to generate possible solutions to this central puzzle of our study.

We looked to resources for understanding this puzzle because past research has found them to be central for explaining developmental disparities experienced by teen parents' children. Using cross-sectional measures of socioeconomic, material, and social resources at age 2, [author citation 2012] found that resources fully explained why prekindergarten children from similar backgrounds experienced worse developmental outcomes if their mother was 18 or 19 years old at birth than if she was 25 to 29 years old. Resources partially explained why children whose mothers were 15 to 17 years old at birth had worse cognitive, behavioral, and health preschool outcomes than those with mothers aged 25 to 29 years. Mothers' parenting behaviors did not explain nearly as much of the disparities as did resources.

Although this study documented the importance of resources, it did not incorporate key insights about the *dynamics of resources* that come from the broader literatures on poverty and social disadvantage. To varying degrees, researchers have identified several dynamics as important for understanding outcomes over the life course, including resource thresholds, concurrence, developmental timing, and persistence. Some of these dynamics involve nonlinear relationships between resources and human development, others include multiple domains of resources, and yet others incorporate time (through developmental timing or duration). Statistical modeling has not historically provided adequate tools for analyzing such complicated resource dynamics, but fairly recent developments have made such studies more feasible. In this study, we used multilevel growth curve analysis to incorporate: (1) time-varying resource measures across multiple domains, (2) age across early childhood from infancy to the start of school, and (3) nonlinear resource dynamics.

Our study focused on the dynamics of *socioeconomic* resources (in the available domains of income, education, and assets) rather than other types. Three of the four typically measured dimensions of socioeconomic status—education, wealth, and income—are included (occupational status is not). A large literature described below has found family income to be important for understanding child development. Wealth, a concept distinct from income, has received more attention in recent years (Aber, Bennett, Conley, and Li 1997; Duncan and Magnuson 2001; Willson, Shuey, and Elder 2007). Wealth may provide cognitively stimulating materials, a better home environment, or a sense of security. In addition, recent research has shown that wealth predicts children's educational outcomes and health beyond income (Conley 2001; Kim and Sherraden 2011; Shanks 2007). Parental education may also provide additional information predicting children's development, as parents of the same income and wealth may allocate resources, cope with stress, or interact with their children differently according to their educational attainment. Thus, it is important to consider multiple types of socioeconomic status.

We consider four potential explanations for why teen parents' children lose developmental ground across early childhood compared to same-age peers. See Figure 1 for an outline of these explanations. The first relies on nonlinear relationships between resources and outcomes, the second on multiple domains, and the last two on modeling the timing of resources. Below, we outline each explanation in turn. In actuality, a combination of explanations may be the best way to explain the widening of developmental disparities over time.

INSERT FIGURE 1 HERE

1. Teen parents' children have resources below necessary thresholds for normative development. The first potential explanation for the widening disparities between teen parents' children and others relies on the idea that relationships between socioeconomic resources and human development are nonlinear. Researchers examining the causal effects of increases in income have found that more money has important effects on child development when families are living in or near poverty, but above this threshold increased income has little impact (Dearing, McCartney, and Taylor 2001; Duncan and Magnuson 2001; Gershoff, Aber, Raver, and Lennon 2007; Mayer 1997). We know from past research that most teen-parent families are living in or near poverty (i.e., in the income range where increases in income matter for children), but most other families are above this income threshold (Mollborn and Dennis 2012). Similarly, education researchers have found that the lack of a high school degree is particularly problematic for later life outcomes because it is a minimum requirement for nearly all attractive employment opportunities (Upchurch and McCarthy 1990). Therefore, education has a nonlinear relationship with life outcomes: A one-year difference in educational attainment from 11 to 12 years (a high school diploma) is often of greater consequence than, say, an increase from 13 to 14 years (Backlund, Sorlie, and Johnson 1999). Teen parents are much more likely than others to lack this threshold credential (Mollborn 2007). Similarly, the acquisition of a particular asset may be more important for children than a broad indicator of a family's wealth or assets. For example, even when selection effects are controlled, children of homeowners stay in school longer and are less likely to become teen mothers than children of renters (Green and White 1997). Children who live in households that have not met these minimum thresholds of resources may not be able to develop optimally. Because children of teen parents are much more likely to live in such households (even after accounting for these families' modest gains experienced over time), they may lose developmental ground relative to peers if a lack of sufficient resources generates accumulating disadvantages. We account for time-varying threshold measures here, and in the next two potential explanations we model more complex dynamics involving these threshold measures.

2. Teen parents' children have concurrently low resources across multiple domains. As we explain below, studies have identified the accumulation of low socioeconomic resources *over time* as an important predictor of child and adult outcomes (Duncan, Brooks-Gunn, and Klebanov 1994; Korenman, Miller, and Sjaastad 1995; Network 2005; Wagmiller et al. 2006; Willson, Shuey, and Elder 2007). Less attention has been paid to the accumulation of low socioeconomic resources *across domains* at the same time point. Past research has found that different domains of socioeconomic status (e.g., income, wealth, and education) independently predict health (Duncan, Daly, McDonough, and Williams 2002; Willson, Shuey, and Elder 2007) and cognitive and socioemotional behavior (Conley 2001; Kim and Sherraden 2011; Shanks 2007).

Other researchers have gone a step further to test whether experiencing simultaneous disadvantages in multiple domains is more detrimental than experiencing one. For example, Bauman and colleagues (2006) simultaneously examined poverty, low parental education, and living in a single-parent household (not itself a marker of socioeconomic status, but a marker of social disadvantage), finding that children who experienced more domains of disadvantage had increasingly higher odds of being in worse health. Although they did not study socioeconomic status, Felitti and colleagues (1998) found that children who had experienced more types of abuse or other major household dysfunction had sharply increased odds of poor health and risky health behaviors in adulthood.

The logic underlying these findings is that adversities accumulate across domains, with multiple disadvantages being more problematic for child health and development than single ones. Our study examines the consequences of multiple domains within socioeconomic disadvantage. Past research has shown that teen-parent families disproportionately tend to experience low educational attainment, income, occupational status, and assets (Furstenberg 2007; Taylor 2009). Thus, children from teen-parent families may be more often exposed than their peers to multiple domains of socioeconomic disadvantage. If experiencing multiple domains of low socioeconomic status sets in motion a process of cumulative disadvantage, then a time-varying measure of multiple domains may explain why teen parents' children lose developmental ground over time compared to peers.

3. Teen parents' children have lower resource levels during earliest childhood. The third potential explanation for the widening disparities is that teen parents' children have their lowest socioeconomic resources at the beginning of life, when they matter the most for future development. Scholars have been looking increasingly earlier in the life course to identify the roots of cumulative disadvantage in life outcomes. Duncan and colleagues (2007) have argued that early childhood investments maximize future payoff. Barker (2002) and others researching birth outcomes (Boardman, Powers, Padilla, and Hummer 2002) have pointed to prenatal conditions as the root of life course disadvantage. Researchers have identified various "critical periods" in early life during which certain conditions must exist for a child to develop optimally (Dietz 1994). If the first year or two of life is a critical period setting children on a future developmental trajectory, then teen parents' children may be particularly disadvantaged. As we noted above, teen-parent families have particularly few resources shortly after the birth, when parents have not yet accumulated enough human capital and resources and parenting demands are at their highest. The lack of crucial resources during this earliest part of childhood may explain why disparities subsequently widen between teen parents' children and others.

4. Teen parents' children have persistently low resources throughout early childhood. One of the best-documented aspects of resource dynamics is the detrimental effect of persistently low socioeconomic resources. Studies have repeatedly found that persistent poverty has a stronger effect than transient poverty on cognitive and behavioral outcomes (Duncan, Brooks-Gunn, and Klebanov 1994; Korenman, Miller, and Sjaastad 1995; Network 2005; Wagmiller et al. 2006), although McLeod and Shanahan (1993) found that concurrent and persistent poverty influenced different mental health outcomes among children. Researchers examining persistently low socioeconomic status have focused almost exclusively on income. However, developmental research would benefit from the inclusion of a more complex construct of economic resources. Past research has found that teen-parent families tend to start out with disproportionately low socioeconomic status and remain so over time (Hoffman 1998). This is true despite the modest gains in socioeconomic status experienced by teen-parent families over time; in other words, these families gain some socioeconomic resources on average but remain at persistently low levels. Our final potential explanation posits that if persistently low socioeconomic resources set in motion a process of cumulative disadvantage, then they can explain why teen parents' children lose developmental ground over time compared to peers.

For the purposes of this study the relationship between socioeconomic resources and child development was conceptualized globally but assessed within specific domains. A developmental perspective on children's growth might usually advocate a narrower domain-specific focus (e.g., on particular aspects of behavior or health), but here we took a broader approach to look at multiple measures across domains. We did this because the disparities experienced by teen parents' children transcend the cognitive, behavioral, and health domains and because each domain is important for understanding children's readiness for the crucial transition to school (Crosnoe 2006, Entwisle et al. 2004). Our analyses first assessed changes over time in disparities between teen-parent families and others in both household resources and child health and cognitive and behavioral development. We then tested each of the four explanations outlined above. Details about operationalization of each of the hypothesized resource dynamics follow.

METHOD

Data

Our data source is the Early Childhood Longitudinal Study-Birth Cohort (ECLS-B), which followed a nationally representative sample of about 10,600 children born in 2001 from infancy through the fall of kindergarten (U.S. Department of Education 2007).[i] No other nationally representative U.S. study has tracked children through these first years of life using parent interviews and direct assessments. The ECLS-B has the advantage of including relatively large subsamples of children of teen parents, representing 12% of the sample at wave 1. All 2001 births registered in the National Center for Health Statistics vital statistics system were eligible, and the sample was drawn using a clustered, list frame design. Children were sampled from 96 counties/county groups. A small number of children with mothers below age 15 at their birth were excluded; there were just 0.6 births per 1,000 for ages 10-14 in 2008, compared to 41.5 for ages 15-19 (Hamilton, Martin, and Ventura 2010).

This study used data from all waves of the survey, conducted when the children were about 11, 24, and 52 months old (typically the fall before the start of kindergarten), and in the fall of their kindergarten year at an average of 66 months old (thus, most children were interviewed in the fall of

2006 but some entered kindergarten at wave 5 in fall 2007). The primary parent, who was almost always the biological mother, was interviewed in person. Because of budgetary constraints, the kindergarten wave selected a random subsample of about 85% of the children who had completed the parent interview of the preschool wave, though all American Indian/Alaska Native children who completed either the 2-year or the preschool wave were included (Snow et al. 2009). The weighted response rates for the parent interview were 74, 93, 91, 92, and 93 respectively for each wave. Attrition between waves 1 and 3 was similar for teen (20 percent) and nonteen parents (16 percent). Our growth curve analysis approach allowed us to keep all children who had data for at least two waves (of waves 1, 2, 3, and kindergarten). Since some of the covariates we used applied to biological mothers, we further restricted our sample to those whose biological mothers completed the parent survey in the available waves of information. Thus, our eligible sample—children who had at least two reading or math outcomes, had biological mothers complete the survey, and who had valid weights and clustering information—included about 8850 children. However, because of missing information on the various outcomes, controls, and resources, the samples for the different outcomes were slightly smaller than this starting sample, with 8500 for reading and math, 8650 for general health and asthma, and 8200 for behavior.[ii]

Measures

<u>Outcomes.</u> We used five different outcome variables to capture different facets of children's well-being: reading, math, behavior, general health, and asthma. Time-varying outcomes were measured at waves 1, 2, 3, and kindergarten, with the kindergarten wave information taken from either wave 4 or wave 5, depending on when the child first enrolled in kindergarten.

The cognitive outcomes came from one-on-one child assessments adapted from reputable assessment batteries developed for other child development studies or for the ECLS-B. As the children were too young for measuring reading and math in the early waves, they were given the

Bayley Short Form – Research Edition (BSF-R) mental assessment at waves 1 and 2, which measured early cognitive development including communication, expressive and receptive vocabulary, problem-solving, and comprehension.[iii] The wave 1 BSF-R mental scale had an overall IRT reliability coefficient of r_{xx}=0.80; for wave 2, the coefficient was r_{xx}=0.98. See Nord and colleagues (2006) and Snow and colleagues (2009) for more information on these and other assessments. In waves 3 and kindergarten, interviewers administered early reading and math assessments adapted from several reputable assessment batteries developed for other large studies of preschoolers, such as the Peabody Picture Vocabulary Test, the Preschool Comprehensive Test of Phonological and Print Processing, the PreLAS® 2000, the Test of Early Mathematics Ability-3, and sister study Early Childhood Longitudinal Study-Kindergarten Cohort (ECLS-K).[iv] Early reading was assessed by a 35-item test covering age-appropriate areas such as phonological awareness, letter recognition and sound knowledge, print conventions, and word recognition (ECLS-B-reported reliability=0.84). Early math was assessed in two stages, routed after the first stage depending on the child's score and evaluating counting, number sense, operations, geometry, pattern understanding, and measurement (ECLS-B-reported reliability=0.89). We used the scale scores for the cognitive, reading and math evaluations, and then standardized each of these scores within each wave, allowing us to compare a child's score relative to his or her peers on the cognitive evaluations in waves 1 and 2 and early reading and math in waves 3 and kindergarten.

The behavior measure was the average of a number of behavioral indicators observed by the interviewer (the Interviewer Observations of Child Behavior assessment at waves 1 and 2), early child care and education provider at wave 3, and kindergarten teacher (drawn from the Preschool and Kindergarten Behavior Scales—Second Edition, the Social Skills Rating System, and the Family and Child Experiences Study, and new questions developed for the ECLS-B at waves 3 and kindergarten), which were then standardized within each wave.[v] The indicators included items such as the number of times the child displayed positive affect, frequency of social engagement, or how often the child showed cooperation. There were 6, 10, 15, and 16 behavior items in waves 1, 2, 3, and kindergarten, respectively. Negative behaviors were reverse coded so that higher behavior scores represented more positive behavior. We used only external, nonparent reports, as there did not seem to be much diversity in parent reports, suggesting some social desirability bias. Alpha reliability scores were 0.80, 0.94, 0.99, and 0.93 for waves 1, 2, 3, and kindergarten, respectively, suggesting that although the child behavior measure was global, it was reliable.

For a global indicator of health, we used the primary parent's report of the child's health status. We coded those reporting very good or excellent health as 1, and those in good, fair, or poor health as 0.[vi] The dichotomous asthma measure was based on whether the parent ever reported that any medical professional had said that the child had asthma.[vii]

Independent Variables. The child's age, taken from a constructed variable at each wave, was rounded to the nearest month and centered with the average age at kindergarten start (5.5 years) set to zero. Other than age and resources, which are described below, the independent variables were all time-invariant background factors. Many of these indicators were collected in more than one interview, allowing us to fill in gaps using reports from later waves when earlier waves were missing. We prioritized reports in the ECLS-B survey over birth certificate reports. In addition, all control variables except for age and teen parent status were centered to the sample mean.

Teen parent status indicated whether or not the child's biological mother and/or father was under the age of 20 at the time of the child's birth. We used each parent's own report when available, filling in missing data from other sources. Several other demographic background factors served as controls. Child gender was an ECLS-B-constructed measure. Child race was constructed by the ECLS-B and coded as white, black, Hispanic, and (because of small sample size among teen-parent families) other race, which included Asian/Pacific Islander, Native American/Alaska Native, and multiracial children. To reflect immigration status, we included indicators of whether the household primary language was English and whether or not the mother was foreign born. The mother's marital status at birth was captured as a dichotomous variable. Whether the child started kindergarten at wave 4 or 5 was taken from an ECLS-B-constructed variable.

Several control variables measured prenatal conditions and birth outcomes. Dichotomous variables indicated whether the biological mother ever smoked or drank at least one alcoholic drink per week during the third trimester of pregnancy. Those either not receiving prenatal care in the first trimester or not receiving care at all were coded as 1, with those receiving care in the first trimester as 0. Birth weight, constructed by ECLS-B, was coded as moderately low ($<$2500g and $\geq$1500g) or very low ($<$1500g) compared to normal ($\geq$2500g). Preterm birth was indicated as birth before 37 weeks' gestation. Birth order was coded as 1 for the mother's first live birth, 2 for second-born, etc.

Other variables measured disadvantaged backgrounds. An indicator measured whether the biological mother's mother had been a teen mother, including a category for missing information (because those who did not live with their mother as a child or whose mother was deceased were not asked this). Indicators measured whether the biological mother had ever repeated a grade in school, whether the mother's family had ever been on welfare when she was between the ages of 5 and 16, and whether the mother lived with both biological parents until age 16. To control for endogeneity bias, we included wave 1 cognitive score, health, asthma, and behavior as time-invariant background indicators, omitting the measure equivalent to the outcome. For example, for the models predicting reading, wave 1 constants for health, asthma, and behavior were included, but not cognitive scores.

Resources. Although our analyses of resource dynamics focused on socioeconomic resources, we included time-varying measures of a variety of financial, material, and social resources in the household. For the kindergarten wave, information from either wave 4 or wave 5 was matched to the child depending on the year that he or she entered kindergarten, with wave 4 measures filling in for wave 5 when those measures were not available. All were centered to the sample mean.

We measured three dimensions of socioeconomic status for use in analyses of resource dynamics: income, education, and wealth. We used an income-to-needs ratio, which coded ECLS-B-constructed (and ECLS-B-imputed, when necessary) household income as a percentage of the survey year's poverty threshold for the appropriate household size. The mother's educational attainment, constructed by the ECLS-B, was a continuous indicator reflecting total years of education, recoded from a categorical measure. A scale of household assets averaged the following dichotomous indicators: whether or not the household owned a car, had stocks or investments, had a checking or savings account, owned its residence, and was not in subsidized housing (Cronbach's alpha = 0.71).

Other resources, including the financial resources described here, were included in initial analyses but not the analyses of more complex resource dynamics. Three measures of government benefits—Women, Infants, and Children (WIC) food supplements, food stamps, and Temporary Assistance for Needy Families (TANF)—were each represented as dichotomous measures. Wave 1 asked about the time since birth, waves 2 and 3 asked about the last year, and wave 4 asked about the time since the child turned 4. Health insurance was captured as a mutually exclusive categorical variable representing coverage through private insurance (the reference group), Medicaid insurance, other government insurance such as state programs or provisions through the Bureau of Indian Affairs, or no insurance. For children with multiple types of insurance, we prioritized private insurance, followed by Medicaid. The mother's paid work status was reflected by three categories: working full-time (40 or more hours per week), working part-time (less than 40 hours), and none.

We also included time-varying measures of social resources. An ECLS-B-constructed variable provided the mother's marital status at each wave. A dichotomous variable indicated whether any household member besides the study child had a special need or disability. Other measures indicated coresidence with any grandparent, or with any other nonparent/partner and nongrandparent adult. A dichotomous variable measured whether respondents had received advice about parenting since the last wave. A measure of nonparental child care was coded as none, 1-29 hours per week, or 30 or more hours per week.

Finally, several variables operationalized the socioeconomic resource dynamics outlined in our competing explanations for the widening gap between teen parents' children and others (see Figure 1 for details). One analysis interacted each socioeconomic measure with child age to model the developmental timing of resources. We created time-varying threshold measures of low resources for each domain: household income below the poverty line, mother's educational attainment less than a high school degree, no car owned, no investments, no bank account, no home owned, and receiving subsidized housing. Two additional time-varying measures were then created from these threshold variables. The first counted during how many waves (to date at a given wave) a child had experienced a low resource. For example, a child living consistently in poverty would have a value of 2 waves in poverty at wave 2 and 4 at the kindergarten wave, while a child never in poverty would have a value of 0 at all waves. Second, we counted how many of the seven domains were below threshold levels for a given child at a given wave, with possible values ranging from 0 to 7.

Analyses

We first analyzed descriptive information to document the existence of growing developmental disparities among children and identify changes over time in resource gaps between teen-parent families and others. The multivariate analyses used growth curve models to predict trajectories for each child outcome (reading, math, behavior, general health, and asthma) by analyzing time points (level 1) nested within individual children (level 2). Thus, child age was the level-1 unit and child was the level-2 unit. Multilevel regression models for continuous outcomes were estimated for all models, including the models for binary measures of health status and asthma diagnosis.[viii]

We first compared trajectories by groups defined by teen parent status, including an interaction between child age and teen parent status to estimate change over time in the trajectories. This interaction term is critical, as it represents the widening disparities between teen parents' children and others. Comparing linear and quadratic functions of child age at level 1, the linear models were the best fit, suggesting that disparities between the two groups changed uniformly with age. These models provided statistically efficient and unbiased estimates of trajectories in child outcomes as linear functions of teen parent status under assumptions of multivariate normality (Raudenbush and Bryk 2002). Including all children who had at least two waves of data minimized the impact of survey attrition. Because the models focused on within-individual change, unmeasured stable differences across children were inherently controlled.

Subsequent models controlled first for time-invariant (level 2) background factors, then for time-varying (level 1) resource measures. We then tested the four explanations in turn by introducing into the latter model specific time-varying (level 1) resource dynamics one at a time (see above and Figure 1). To test explanation 1 (resource thresholds), we introduced a time-varying measure of having a low level of each resource. To test explanation 2 (multiple domains), we used a time-varying measure of the number of domains of low socioeconomic resources experienced at each wave. To test explanation 3 (critical period), we introduced interactions of child age with each socioeconomic resource. To test explanation 4 (persistently low resources), we included a time-varying measure, for each socioeconomic resource, of the number of waves to date when the child had experienced a low level of that resource. Explanations were considered successful if they met mediation criteria (Baron and Kenny 1986) in explaining growth in disparities between teen parents' children and others (i.e., the interaction between teen parent status and child age). These criteria, as well as model fit, helped us compare the effectiveness of the different explanations for the widening developmental gaps experienced by teen parents' children.

We estimated the models using the "xtmixed" command in Stata 12. Probability weights were used to make findings representative of all children born in the United States in 2001, and the sandwich estimator of standard errors adjusted for clustering within the primary sampling units. We assigned one unique variance parameter per random effect and assumed that covariance parameters were zero.

The form of the basic multilevel model for person *i* at time *t* is:

$$S_{ti} = \beta_{0i} + \beta_{1i}(A_{ti} - L) + \Sigma \beta_{ki} X_{kti} + r_{ti} \qquad (1)$$

$$\beta_{0i} = \gamma_{00} + \Sigma \gamma_{0j} W_{ji} + u_{0i}, \qquad (2a)$$

$$\beta_{1i} = \gamma_{10} + \Sigma \gamma_{1j} W_{ji} + u_{1i}, \qquad (2b)$$

$$\beta_{ki} = \gamma_{k0}. \qquad (2c)$$

The coefficient β_{1i} is a random effect estimating the linear increase (at the centered value L of age 5.5) in the developmental trajectory for each child. We treated the β_{ki} coefficients for k level-1 time-varying variables as fixed (i.e., $\beta_{ki} = \gamma_{k0}$). The γ coefficients for j time-invariant W variables showed how stable background characteristics (e.g., teen parent status) altered the level of each outcome at age 5.5 in 2a and the linear age trajectories of each outcome over time in 2b. We used the Bayesian Information Criterion (BIC) and the Akaike Information Criterion (AIC) to assess model fit and improvement in fit across models. The starting value for these fit statistics is not of consequence, but a decrease in the number indicates an improvement in fit.

RESULTS

Documenting the Consequences of Teen Parenthood

Widening developmental disparities over time. Both the descriptive information presented in Table 1 and the baseline model from the multivariate growth curve analyses summarized in Table 2 and Figure 2 (left side) show the same result: For every outcome, teen parents' children increasingly fell behind their peers across early childhood. Across the five measures of cognition, behavior, and health, teen parents' children started with a level playing field in infancy (despite having compromised birth weight and preterm birth outcomes as documented in Table 1), but early in childhood their average outcomes became poorer than those of same-age peers. By the average age at kindergarten start (5.5 years, represented by the main effect of having a teen parent in Table 2 and by the point marked with stars on the graphs in Figure 2), these disparities were substantial for each outcome. Descriptive information from Table 1 shows that in the fall of kindergarten, teen parents' children lagged behind their peers by nearly half a standard deviation in reading and math and one third of a standard deviation in teacher-observed behavior. They were 5 percent less likely to be in very good or excellent health as reported by their primary parent and 56 percent more likely to have ever received a diagnosis of asthma (fully one quarter of children with a teen parent had asthma at some point before the start of kindergarten). Compared to Table 1, the baseline growth curve model summarized in Table 2 reflects similar magnitudes of relationships at kindergarten start (as evidenced by the main effect of teen parent status, which was centered to age 5.5), with significant differences between teen parents' children and others at this time point for every outcome. The interaction between teen parent status and child age represents the linear change over time in outcomes between teen parents' children and others, showing that the disparity in cognitive/reading and cognitive/math scores increased by about 0.1 standard deviations per year, the behavior disparity increased by about 0.06 standard deviations per year, and disparities in health status and asthma diagnosis increased by about 1 percentage point per year. These widening disparities are graphically represented by the left-side graphs in Figure 2.

INSERT TABLES 1 AND 2 AND FIGURE 2 HERE

Subsequent models reported in Table 2 adjusted these growth curves for background variables and a wide variety of resources. Past research has found that parents' background characteristics and children's birth circumstances explain all or part of the developmental disparities between teen parents' children and others (Geronimus and Korenman 1993; Levine, Pollack, and Comfort 2001; Turley 2003). Adding time-invariant controls reduced some of the relationships between teen parent status, growth over time, and child outcomes, but these changes were generally modest, as evidenced by the stability of the teen parent*age interaction terms. Including a wide variety of time-varying measures of socioeconomic, material, and social resources further explained part of the disparities at average kindergarten start (as evidenced by the main effect of teen parent status in Table 2, third model), but with the exception of behavior these age 5.5 outcomes were still significantly different between teen parents' children and others. Interestingly, the teen parent*age interaction term is not reduced, showing that time-varying resources and controls did not at all explain the *growth* in disparities between teen parents' children and their peers (they partially explained the developmental gap at kindergarten start rather than how it grew over time), emphasizing the need to consider resource dynamics as explanations for these increasing gaps.

<u>Steady or shrinking resource gaps over time.</u> To assess how the resources of teen-parent families were changing relative to those of other families during the high-demand period of early childhood, we included descriptive information in Table 1. Descriptive analyses found that teen-parent families held steady or improved their socioeconomic situations—but typically less substantially than their children's simultaneous loss of developmental ground compared to peers. Among the measures of socioeconomic status, teen-parent families' gains were not significantly

different from their peers' gains in income or assets (either the asset scale or specific asset types). Mothers in teen-parent families gained significantly more education from their child's infancy to kindergarten, with an average gain of 0.76 years compared to 0.15. In terms of critical socioeconomic thresholds, half again as many teen mothers had a high school diploma at the kindergarten wave as in the child's infancy, and 25% fewer teen-parent families were living in poverty at this later time ($p<.05$ for both). Among the broader resource measures, teen-parent families gained relative to their peers in food stamp receipt, private health insurance, full-time work, marriage, grandparent coresidence, and full-time child care. The only unequivocally problematic resource loss they experienced relative to peers was in the domain of parenting advice and help.[ix] But even after these gains, teen-parent families still had sharply lower levels of resources than their peers at kindergarten start. For example, their average income was 160% of the federal poverty line, compared to 373% for others, and mothers' educational attainment was 11.90 years compared to 13.83 years for others. One fifth more mothers were without paid work at the kindergarten wave in teen-parent families, and just half as many were married.

In sum, descriptive findings show that teen-parent families were not losing ground compared to other families during their children's early years; rather, they were holding steady or even slightly closing the large gap for some types of resources. However, these gains still left teen parents and their children in a very disadvantaged socioeconomic position compared to families headed by older parents. This supports what is known from previous research about the gradually improving socioeconomic circumstances of teen parents and thus confirms the existence of the empirical puzzle with which we began.

Explaining Why Teen Parents' Children Lose Developmental Ground

The remaining analyses investigated the widening developmental disparities of teen parents' children relative to others by testing the four explanations outlined above. Multivariate growth curve models, summarized in Table 2, tested each explanation in turn. The full models are displayed for the cognitive/math outcome in Table A1 (see Appendix), and complete tables for other outcomes are available upon request.

Explanation 1: Resources below necessary thresholds. The first explanation we tested suggested that teen parents' children lose developmental ground over time compared to peers because their households disproportionately have resources below threshold levels necessary for typical development. Descriptive analyses found that for each of the seven threshold measures, teen-parent families were indeed significantly more likely than others to be below the threshold at either wave 1 or kindergarten. For example, at both of these waves children with a teen parent were more than twice as likely as others to be living in poverty, have a mother with no high school diploma, or have no family car or home ownership. However, although measures from all three socioeconomic domains predicted cognitive outcomes and health status as expected, the multivariate models did not support the resource threshold explanation for growing disparities between teen parents' children and others. Replacing the time-varying continuous measures of socioeconomic status with time-varying threshold measures, detailed above and in Table 2, did not reduce the magnitude of the interactions between teen parent status and child age or improve the fit of the models relative to the continuous measures, except for a slight improvement in model fit for health status.

INSERT TABLE A1 HERE

Explanation 2: Concurrently low resources in multiple domains. The second explanation posited that concurrently low resources in multiple domains disproportionately experienced by teen parents' children would explain why they lagged increasingly behind others over time. We did not find support for this explanation. Again, descriptive information provided initial support, with teen parents experiencing a significantly higher number of domains with low resources at wave 1 (2.95 domains compared to 2.01) and at kindergarten (2.71 domains compared to 1.97); note that the gap did close slightly during this period. However, in multivariate analyses, the magnitude of the interactions between child age and teen parent status did not decrease at all with the introduction of a time-varying measure of the number of domains with low resources experienced in a child's household, summarized in Table 2. The time-varying measure of multiple domains of low resources significantly predicted children's health status and asthma, but not their cognitive or behavioral outcomes. These findings suggest that although concurrently low resources in many domains may be fruitful to consider in the future for understanding child health, they did not explain differing trajectories for teen parents' children compared to others.

Explanation 3: Fewer resources in earliest childhood, when resources matter most. We tested the third explanation, which was supported by descriptive statistics about change in resources over time, by introducing interactions between child age and socioeconomic resources in the "timing of resources" model in Table 2. These interactions were added separately because of data limitations resulting from having just four waves of data. Interactions between child age and resources showed that far from mattering more in earliest childhood as we expected, socioeconomic resources actually predicted children's outcomes more strongly closer to the transition to school. For every outcome and every resource type (except maternal education for behavior), the relationship between the resource and child outcomes was significantly stronger the older the child became. Because it was in the opposite of the expected direction, this finding did not support explanation 3.

The interactions between child age and socioeconomic resources did, however, partially and unexpectedly explain the growing disparities in outcomes between teen parents' children and others. Especially because it identifies the strongest relationships at the end of the time period we study, this finding does not help us understand how teen parents' improving socioeconomic circumstances can be accompanied by worsening outcomes among their children. But it is still an interesting finding: Teen-parent families experienced sizeable gaps in resources relative to others throughout early childhood, and resources in the latter part of this period were unequivocally important for understanding how teen parents' children fared at the start of the crucial transition to school.

Explanation 4: Persistently low resources throughout childhood. The idea that teen parents' children disproportionately experienced persistently low resources throughout early childhood, and that this persistence would explain why they lagged behind peers developmentally, turned out to be the most powerful of our potential explanations. The descriptive information in Table 1 showed that teen parents' children were more likely than peers to experience persistently low resources in every socioeconomic domain ($p<.001$ for all comparisons). For example, at entry to kindergarten wave the typical child of a teen parent had been living in poverty for 1.81 waves, compared to 0.75 waves for an average child with no teen parents. The typical child of a teen parent had spent 1.43 waves with a mother who did not have a high school diploma, compared to 0.52 waves for the typical peer. Teen parents' children had lived for 3.28 waves in households that did not own their residence, compared to 1.60 waves.

These differences in persistently low socioeconomic resources also explained why children of teen parents were experiencing increasing developmental disparities over time. Table 2 shows that accounting for time-varying measures of persistently low income, maternal education, and various assets in Table 2 explained half or more of the magnitude of the interaction between child age and teen parent status predicting reading, health status, and asthma. In the case of cognitive/math and behavior scores, accounting for persistently low resources eliminated the growing disparity between teen parents' children and others completely. In Table 2, the importance of persistently low resources for child outcomes was apparent for each of the three socioeconomic dimensions, but the long-term financial "safety net" indicators of investments and home ownership were the most consistently predictive of children's outcomes. The single most important persistently low resource (as indicated by coefficient size across the seven dichotomous variables) differed by outcome: for cognitive/reading and cognitive/math it was a persistent lack of investments; for behavior, home ownership; for health status, maternal high school diploma; and for asthma, income above the poverty line. Comparisons of model fit using the BIC and AIC showed (in Table A1 and supplemental analyses) that the models accounting for persistently low resources had the best fit of any models. The right-hand side of Figure 2 displays predicted growth curves of the five outcomes for teen parents' children compared to others after persistently low resources were introduced into the models. The difference between the left and right side shows how much the growing disparities were explained by accounting for persistently low resources in teen-parent households.

One supplemental finding from our multivariate models is particularly noteworthy. Beyond being the best explanation for understanding why children of teen parents experienced widening developmental disparities over time, the persistence hypothesis also did the best job of partially or completely explaining disparities in children's developmental trajectories by race/ethnicity and primary household language across all outcomes. Because it would have taxed the data too much, we could not interact these demographic variables with child age in our models, so these findings do not address widening disparities in the way the teen parent results do.

DISCUSSION

In this study, our overarching theoretical aim was to clarify and operationalize dynamic socioeconomic processes that could be useful for understanding the accumulation of advantage and disadvantage in development and health throughout the life course. Past research has documented some of these dynamics, such as persistently low income, but others like the accumulation of socioeconomic disadvantage across domains have not been studied empirically. We also innovated in bringing together multiple domains of socioeconomic status to analyze these processes in the important and understudied period from infancy through the transition to school. Reputable direct assessments in the nationally representative ECLS-B survey permitted us to consider a variety of developmentally appropriate longitudinal outcomes in the areas of cognition, behavior, and health using multilevel growth curve modeling. The specific cause of cumulative disadvantage in these outcomes that we studied was being born to a teen parent. In choosing this empirical case, we set out to document and explain why the young children of teen parents lose ground relative to their peers across early childhood in terms of cognition, behavior, and health. This is particularly puzzling given that teen-parent families' socioeconomic circumstances hold steady or improve during the same time period.

Our analyses of ECLS-B data confirmed that teen parents' children experienced sharply increasing disparities over time in every domain (e.g., cognitive scores went from parity during infancy to a gap of one half of a standard deviation at kindergarten start). We evaluated four potential explanations for these growing developmental gaps. One of our explanations, persistently low resources, received strong support. Teen parents' children were much more likely to experience socioeconomic resources that were persistently below minimum thresholds in every domain. This was true even though some socioeconomic outcomes improved over time—children still experienced relatively low average levels of resources at all time points. This persistence predicted compromised health and development and explained much or all of the growth over time in outcome disparities between teen parents' children and their peers. In DiPrete and Eirich's (2006) influential categorization of types of cumulative advantage, this explanation is a "cumulative exposure" process. Past studies have identified persistently low income as a major risk factor for child development (Duncan, Brooks-Gunn, and Klebanov 1994; Korenman, Miller, and Sjaastad 1995; McLeod and Shanahan 1993; Network 2005; Wagmiller et al. 2006), and here we also found it to be an important explanation for the accumulation of disadvantage in marginalized children's development and health. We expanded beyond income measures to examine the education and asset domains, and each of the three was the most important predictor for a specific child outcome. For measurement purposes we used threshold measures of persistence here, but future research could consider whether this mechanism works best when conceptualized as resource thresholds or gradients.

As a first step in modeling resource dynamics in early childhood across multiple socioeconomic measures and child outcomes, this study has limitations that should be addressed in future research. One traditional aspect of socioeconomic status, occupational status, was omitted because of data limitations. Further research should expand beyond socioeconomic status to model dynamic processes in the wide variety of material, financial, and social resources documented in the ECLS-B. Also, sensitivity analyses should establish the exact location of thresholds for nonlinear resource effects, and teen parents' own socioeconomic resources should be considered separately from those of their broader households. Analyses of outcomes for teen parents' children should differentiate between children of younger and older teen parents (whose situations may differ systematically), as well as children who were born to a teen mother, a teen father, or both. A narrower analysis of child outcomes could consider separate subscales of child behavior available in the ECLS-B, such as internalizing and externalizing problem behaviors and approaches to learning. Because children develop so rapidly in the early years, the assessments necessarily had to differ across age, but this limited their comparability. Finally, the ECLS-B is the only nationally representative longitudinal survey of early childhood ever collected in the United States, but surveys including more than four time points may be able to uncover nonlinearities in relationships over time using the same multilevel growth curve framework.

This study has found that newer, dynamic ideas about socioeconomic resources can advance understanding children's development and health throughout the early years of life, particularly in our empirical case of the consequences of teen childbearing. Our research suggests that scholars seeking to understand stratification processes in early childhood will be served by modeling key principles of the life course theoretical perspective (Elder 1998) when designing their research. For example, a longitudinal and multidimensional focus on resources in early childhood appears to be key for understanding the implications of having a teen parent, and cumulative disadvantage in resources over time is a crucial process.

Dynamic ideas about socioeconomic disadvantage are necessarily more complex to operationalize than static ones, but we have shown that growth curve analysis accommodates them. Time-varying, cumulative measures of different types of resources can be constructed and included in the same model that captures development trajectories from infancy through kindergarten entry. Importantly, in a growth curve framework these cumulative measures can predict the interaction of a source of social stratification (such as teen childbearing) with child age, distinguishing an effect on development at a single point in time (such as kindergarten entry) from an effect on change over time in the developmental disparity. Using this empirical framework, future research should apply the dynamic of persistently low resources to understand other sources of cumulative disadvantage beyond teen childbearing. The modeling of multidomain disadvantage and resource thresholds demonstrated in this study may also be important for understanding other sources of disparities in early child development. Future research could also assess the presence of nonlinear relationships between socioeconomic resources and child outcomes over time.

Theoretically, our findings imply that cross-sectional measures of resources likely underestimate the effects of socioeconomic disadvantage on child development and health. Studies focusing on one particular type of socioeconomic resource, such as poverty, also miss strong relationships of other facets with children's outcomes. Relatedly, cross-sectional approaches or those focused on a single aspect of socioeconomic status may underrate the importance of resources for understanding the negative consequences of teen childbearing for children. The broad and longitudinal view of resources permitted by the ECLS-B data highlights their importance more than ever for understanding early child development.

Similarly, our broad approach to operationalizing child outcomes illuminates overarching patterns across very different developmental domains. The overall consistency of our findings across developmental domains suggests that although there is obvious merit in domain-specific studies of child development, researchers who take a broader multidimensional view of child outcomes may be able to uncover more general processes of resource dynamics and cumulative disadvantage. Our research points toward prekindergarten and the transition to school, as well as the accumulation of resources over time, as a focus of future research on the effects of socioeconomic disadvantage in early childhood. This does not negate the importance of work focusing on prenatal and birth circumstances, but it does emphasize that the entire period of early childhood, from conception through the start of school, should be a strong future focus.

Although this observational study cannot establish causality according to the gold standard of a randomized intervention, it does suggest preliminary implications for social policy. As life course scholars have long known, policies looking to improve a child's development or health need to consider the resource situation the child has experienced throughout his or her life rather than relying on a static snapshot. For all their substantial developmental and health disadvantages at the start of schooling, children of teen parents are by no means set on an irreversible developmental trajectory. Income transfers, support for parental education, and the provision of a long-term safety net are promising strategies for intervening before the transition to school—and our analyses advocate a focus on "bumping up" household resources above minimum thresholds. Interrupting patterns of persistently low resources may be key. Early interventions that relieve persistently low resources over time are likely to be particularly effective, but because resources in the household matter increasingly more for young children's outcomes as they age, even resource transfers closer to kindergarten may be effective. This also suggests that policies in the years following a teenage birth can help two generations for the price of one: Programs that help teen parents improve their own socioeconomic circumstances, such as school and work programs or child care support, may also prevent the accumulation of developmental disadvantage in their children. Because past research has shown that teen parents are highly motivated to improve their socioeconomic lot shortly after the birth (Edin and Kefalas 2005; SmithBattle 2007) and because teen parents' children constitute the majority of children living in poverty (author citation 2012), policies that help teen-parent families can also be effective antipoverty policies.

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Table 1. Weighted Means for Time-Invariant and Time-Varying Variables

Variable	Wave 1 No Teen Parent	Wave 1 Teen Parent		Wave K No Teen Parent	Wave K Teen Parent		Change from W1 to WK No Teen Parent	Change from W1 to WK Teen Parent	
Child age in months (6-85)	10.51	10.52		66.14	66.20				
Background controls (time-invariant)									
Male°	0.51	0.52							
Race/ethnicity (White)	0.57	0.37	***						
Black	0.12	0.22	***						
Hispanic	0.24	0.35	***						
Other Race	0.07	0.05	**						
Non-English household	0.18	0.21	*						
Birth weight (normal)	0.93	0.90	***						
Low	0.06	0.08	***						
Very low	0.01	0.02	***						
Preterm birth°	0.11	0.15	**						
Smoked during pregnancy°	0.11	0.15	***						
Drank during pregnancy°	0.01	0.00	***						
Late/no prenatal care°	0.07	0.17	***						
Birth order of study child	2.13	1.33	***						
Biological mother married at birth	0.74	0.23	***						
Biological mother foreign born°	0.20	0.17	*						
Grandmother was teen mom (no)	0.71	0.63	***						
Yes	0.11	0.14	*						
Unknown	0.18	0.22	*						
Mother ever repeated grade°	0.14	0.23	***						
Mother on welfare growing up°	0.09	0.21	***						
Mother lived with two parents until 16°	0.61	0.39	***						
Child outcomes (time-varying)									
Cognitive/math	0.19	0.15		-0.04	-0.49	***	-0.33	-0.73	***
Cognitive/reading	0.19	0.15		-0.07	-0.53	***	-0.36	-0.77	***
Positive behavior	0.11	0.13		0.06	-0.25	***	-0.01	-0.42	***
Very good/excellent health°	0.89	0.86	*	0.87	0.83		-0.02	-0.05	
Ever had asthma diagnosis°	0.05	0.06		0.16	0.25	**	0.11	0.18	*
Household resources (time-varying)									
Income (proportion of poverty line)	3.13	1.26	***	3.73	1.60	***	0.53	0.30	
Asset scale	0.72	0.46	***	0.76	0.50	***	0.04	0.04	
Received WIC in last 12 months°	0.46	0.89	***	0.20	0.40	***	-0.25	-0.51	***
Household received food stamps°	0.17	0.35	***	0.18	0.48	***	0.02	0.15	***
Household received TANF°	0.06	0.18	***	0.05	0.15	***	-0.01	-0.02	
Mother received parenting help°	0.10	0.20	***	0.06	0.06		-0.04	-0.16	***
Health insurance type (private only)	0.63	0.19	***	0.69	0.35	***	0.06	0.13	**
Medicaid	0.28	0.65	***	0.19	0.49	***	-0.06	-0.12	
Other government	0.06	0.10	**	0.07	0.09		0.00	-0.01	
None	0.04	0.06	*	0.04	0.06		0.00	0.00	
Household member with special needs°	0.07	0.09		0.11	0.09		0.03	-0.01	
Mother's years of education	13.55	11.06	***	13.83	11.90	***	0.15	0.76	***
Mother's employment (none)	0.45	0.59	***	0.35	0.42	*	-0.09	-0.12	
Part time	0.26	0.24		0.27	0.25		0.03	-0.02	
Full time	0.29	0.17	***	0.37	0.33		0.06	0.14	*
Mother currently married°	0.74	0.26	***	0.75	0.37	***	0.00	0.16	***
Grandparent in residence°	0.10	0.45	***	0.16	0.62	***	0.06	0.13	**
Other adult in residence°	0.08	0.26	***	0.07	0.18	***	-0.03	-0.09	*
Nonparental child care (none)	0.51	0.44	***	--	--		--	--	
Part time	0.20	0.25	**	0.26	0.15	***	0.07	-0.11	***

Full time	0.29	0.31		0.73	0.85	***	0.42	0.51	*
Resource dynamics (time-varying)									
Count of waves to date with low resource:									
Below poverty line	0.21	0.51	***	0.75	1.81	***	0.56	1.32	***
Mother has less than HS degree	0.14	0.51	***	0.52	1.43	***	0.38	0.95	***
No car	0.08	0.23	***	0.29	0.81	***	0.21	0.58	***
No investments	0.54	0.89	***	2.09	3.56	***	1.56	2.70	***
No bank account	0.22	0.46	***	0.84	1.71	***	0.62	1.29	***
Not homeowners	0.46	0.86	***	1.60	3.28	***	1.13	2.40	***
Free/subsidized housing	0.11	0.26	***	0.37	1.12	***	0.27	0.80	***
Count of domains at low resource	2.01	2.95	***	1.97	2.71	***	-0.01	-0.18	*
Below poverty line°	0.21	0.51	***	0.16	0.38	***	-0.03	-0.12	*
Mother < high school degree°	0.14	0.51	***	0.13	0.27	***	-0.01	-0.21	***
No car°	0.08	0.23	***	0.06	0.17	***	-0.03	-0.06	
No investments°	0.54	0.89	***	0.51	0.90	***	-0.02	0.01	
No bank accounts°	0.22	0.46	***	0.20	0.39	***	-0.02	-0.05	
Not homeowners°	0.46	0.86	***	0.35	0.78	***	-0.12	-0.10	
Free/subsidized housing°	0.11	0.26	***	0.08	0.27	***	-0.02	-0.04	

Notes: Source: Early Childhood Longitudinal Study-Birth Cohort, 2001-2007.Wave 1 N≈9250; Wave K N≈4400; Change from W1 to WK N≈4400. Analyses account for sample design effects. Range for age and continuous outcome variables are in parentheses. ° 1 = yes.
* p<.05 ** p<.01 *** p<.001; two-tailed design-based F tests comparing children with a biological parent under the age of 20 with children with both biological parents age 20 or greater at time of birth.

Table 2. Summary of Unstandardized Coefficients from Multilevel Linear Regression Models of Child Outcomes

	Cognitive/ math	***Cognitive/ reading***	***Positive behavior***	***Very good/ excellent health***	***Asthma diagnosis***
Variable Information	Mean 0, standard deviation 1			0 = no or 1 = yes	
Baseline model					
Teen parent	-0.490***	-0.513***	-0.324**	-0.065***	0.085***
Teen parent*child age	-0.090***	-0.095***	-0.060*	-0.009***	0.013***
Add time-invariant controls					
Teen parent	-0.372***	-0.412***	-0.249*	-0.046***	0.033***
Teen parent*age	-0.089***	-0.095***	-0.059*	-0.009***	0.013***
Add time-varying resources					
Teen parent	-0.277***	-0.314***	-0.197	-0.036***	0.030*
Teen parent*age	-0.091***	-0.097***	-0.059*	-0.011***	0.013***
#1: Time-varying resource thresholds					
Teen parent	-0.309***	-0.347***	-0.201*	-0.037***	0.031**
Teen parent*age	-0.092***	-0.098***	-0.057*	-0.013***	0.013***
Below poverty	-0.051***	-0.049***	-0.008	-0.023*	0.014***
< high school degree	-0.081***	-0.089***	0.023	-0.032***	-0.003***
No car	0.016	0.016	-0.010	-0.005***	0.002
No investments	-0.094*	-0.106***	-0.033***	-0.003*	-0.001
No bank accounts	0.018	0.006	-0.010	-0.003	0.001
Not homeowners	-0.034***	-0.042***	-0.090***	-0.011***	0.001
Has subsidized housing	0.013	0.011*	0.055*	-0.003	0.020
#2: Multiple domains of low resources					
Teen parent	-0.277***	-0.314***	-0.197	-0.036***	0.030*
Teen parent*age	-0.091***	-0.097***	-0.059*	-0.012***	0.013***
Count of low resources	-0.009	-0.008	0.006	-0.016***	0.002**
#3: Timing of resources					
Teen parent	-0.118***	-0.159***	-0.156	-0.017***	0.018
Teen parent*age	-0.035***	-0.042***	-0.045	-0.005*	0.008**
Income*age	0.022***	0.022***	0.006*	0.002*	-0.001***
Asset scale*age	0.222***	0.217***	0.055***	0.027***	-0.018***
Mom's education*age	0.025***	0.026***	0.003	0.002*	-0.0005*
#4: Persistently low resources					
Teen parent	-0.024	-0.086***	-0.151	-0.009*	0.009
Teen parent*age	-0.015	-0.028***	-0.042	-0.005***	0.007**
Count of waves to date:					
Below poverty	-0.069*	-0.054*	-0.008	-0.011***	0.012*
< high school degree	-0.026***	-0.026***	0.044***	-0.018***	-0.001
No car	-0.040***	-0.039***	-0.015	0.000	0.004
No investments	-0.161***	-0.148***	-0.040	-0.007*	0.007***
No bank accounts	-0.045***	-0.047***	-0.009**	-0.009	-0.005
Not homeowners	-0.054***	-0.050***	-0.039***	-0.004***	0.005***
Has subsidized housing	-0.061***	-0.044***	-0.009	0.008	0.018

Notes: Source: Early Childhood Longitudinal Study-Birth Cohort, 2001-2007.
N people ≈ 8450 and *N* person-time ≈ 27450 for cognitive/math and cognitive/reading, 8350 and 25500 for behavior, 8600 and 28650 for health and asthma. Model 1 controls for child's age at assessment. Models 2 through 4 add specified variables to the previous model, Model 7 adds specified variables to Model 2, and Models 5 and 6 add specified variables to Model 3. Model 4 shows results for assets*child age, though findings were similar for income*child age and maternal education*child age. "Controls" include control variables specified in the data section. Analyses account for probability weights and clustering. * p<.05 ** p<.01 *** p<.001; two-tailed tests.

Table A1. Unstandardized Coefficients from Multilevel Linear Regression Models of Child Cognitive/Math Scores

Variable	Model 1 (Base)	Model 2 (Add controls)	Model 3 (Add resources)	Model 4 (Resource thresholds)	Model 5 (Multiple domains)	Model 6 (Resource timing income)	Model 6 (Resource timing assets)	Model 6 (Res. timing education)	Model 7 (Persistently low resources)
Child age (in years)	-0.032 ***	-0.030 ***	-0.031 ***	-0.033 ***	-0.031 ***	-0.109 ***	-0.200 ***	-0.381 ***	0.051 ***
Any teen parent°	-0.490 ***	-0.372 ***	-0.277 ***	-0.309 ***	-0.277 ***	-0.161 ***	-0.118 ***	-0.131 ***	-0.024
Child age*any teen parent	-0.090 ***	-0.089 ***	-0.091 ***	-0.092 ***	-0.091 ***	-0.049 ***	-0.035 **	-0.036 ***	-0.015
Time-Invariant Controls									
Male°		-0.142 ***	-0.145 ***	-0.144 ***	-0.145 ***	-0.143 ***	-0.143 ***	-0.145 ***	-0.144 ***
Child race/ethnicity (white)									
Black		-0.185 ***	-0.150 **	-0.156 **	-0.150 **	-0.148 **	-0.144 *	-0.146 *	-0.094
Hispanic		-0.192 ***	-0.136 ***	-0.165 ***	-0.135 ***	-0.130 ***	-0.130 ***	-0.131 ***	-0.105 ***
Other race		-0.019 **	-0.030 **	-0.012	-0.029 **	-0.033 *	-0.034 **	-0.031 **	-0.021
Household primary language not English°		-0.121 ***	-0.067 ***	-0.077 ***	-0.067 ***	-0.077 ***	-0.069 ***	-0.064 ***	-0.021 ***
Birth weight (normal)									
Moderately low		-0.228 ***	-0.231 ***	-0.230 ***	-0.231 ***	-0.230 ***	-0.230 ***	-0.230 ***	-0.236 ***
Very low		-0.349 ***	-0.342 ***	-0.341 ***	-0.342 ***	-0.340 ***	-0.340 ***	-0.340 ***	-0.345 ***
Preterm birth°		-0.111 *	-0.111 *	-0.111 *	-0.111 *	-0.112 *	-0.111 *	-0.112 *	-0.109
Smoked during pregnancy°		-0.144 ***	-0.056 **	-0.088 ***	-0.055 **	-0.057 ***	-0.054 **	-0.057 **	-0.030
Drank during pregnancy°		0.207 *	0.108	0.175 *	0.109	0.106	0.102	0.105	0.121
No/late prenatal care°		-0.088 ***	-0.062 ***	-0.064 ***	-0.062 ***	-0.062 ***	-0.061 ***	-0.064 ***	-0.046 ***
Birth order		-0.061 ***	-0.027 *	-0.042 **	-0.027 *	-0.030 *	-0.027 *	-0.028 *	-0.023
Mother married at birth°		0.101 ***							
Mother foreign born°		-0.033 ***	-0.026 ***	-0.026 ***	-0.025 ***	-0.024 ***	-0.022 ***	-0.025 ***	-0.011 ***
Mother born to a teen mother (yes)									
No		-0.033 ***	-0.009	-0.021 *	-0.008	-0.006	-0.004	-0.007	0.001
Information missing		-0.038 ***	-0.021 **	-0.028 **	-0.021 **	-0.019 *	-0.016 +	-0.019 *	-0.016 ***
Mother ever repeated a grade°		-0.141 ***	-0.070 +	-0.092 **	-0.070 +	-0.073 +	-0.072 +	-0.071 +	-0.047
Mother on welfare as a child°		-0.062 ***	-0.018	-0.031 ***	-0.018	-0.015	-0.017 +	-0.021 +	-0.005
Mother lived with both parents°		0.045 ***	0.026 *	0.041 ***	0.026 *	0.028 *	0.028 **	0.027 *	0.024 *
Wave 1 constants									
Asthma		0.020	0.042 ***	0.034 ***	0.042 ***	0.040 ***	0.041 ***	0.039 ***	0.051 ***
Behavior score		0.101 ***	0.099 ***	0.098 ***	0.099 ***	0.100 ***	0.099 ***	0.100 ***	0.099 ***
Health		-0.032 +	-0.022	-0.027 +	-0.022	-0.023	-0.023	-0.023	-0.022
Time-Varying Resources									
Income (proportion of poverty line)			0.029 ***		0.028 ***	0.086 ***	0.027 ***	0.026 ***	0.017 ***
Asset scale			0.006		-0.007	0.009	0.630 ***	0.006	-0.532 ***
Health insurance (private only)									
Medicaid			-0.020	-0.042	-0.018	-0.032	-0.033	-0.027	0.035

Other government			-0.035	-0.060	-0.035	-0.029	-0.034	-0.028	0.003
None			0.057	0.033	0.066	0.050	0.041	0.042	0.081
Household member special needs°			-0.144 ***	-0.146 ***	-0.135 ***	-0.138 ***	-0.141 ***	-0.143 ***	-0.137 ***
Mother's education (years)			0.038 ***		0.037 ***	0.037 ***	0.038 ***	0.106 ***	0.022 *
Received WIC°			0.054	0.018	0.054	0.017	0.018	0.019	0.030
Received food stamps°			-0.068 +	-0.073 *	-0.066 +	-0.042	-0.046	-0.050	0.000
Received TANF°			-0.019	-0.015	-0.019	-0.024 +	-0.027 **	-0.024	-0.033 ***
Got parenting help or advice°			-0.026	-0.026	-0.035	-0.031	-0.034	-0.024	-0.040
Mother's paid work (none)									
Part-time			0.011 ***	0.017 ***	0.011 ***	0.014 ***	0.017 **	0.010 ***	0.016
Full-time			0.031 ***	0.037 ***	0.031 ***	0.039 ***	0.035 ***	0.028 ***	0.031 ***
Mother currently married°			-0.017	-0.004	-0.017 +	-0.013	-0.017 +	-0.008	-0.029 ***
Any coresident grandparent°			-0.023	-0.036 +	-0.023	-0.012	-0.006	-0.015	-0.012
Any coresident other adult°			-0.035 **	-0.046 ***	-0.035 *	-0.044 **	-0.045 **	-0.043 **	-0.036 *
Nonparental child care (none)									
Part-time			0.006	0.018	0.006	0.008	-0.006	0.012	-0.016 +
Full-time			0.019 *	0.040 ***	0.019 *	0.018 *	0.016 +	0.025 *	0.027 ***
Below poverty line°				-0.051 ***					
Mother < high school degree°				-0.081 ***					
No car°				0.016					
No investments°				-0.094 *					
No bank accounts°				0.018					
Not homeowners°				-0.034 ***					
Has subsidized housing°				0.013					
Count of current domains of low resources					-0.009				
Age*income (% of poverty line)						0.022 ***			
Age*asset scale							0.222 ***		
Age*mother's education (years)								0.025 ***	
Count of total waves to date:									
Below poverty line									-0.069 *
Mother < high school degree									-0.026 ***
No car									-0.040 ***
No investments									-0.161 ***
No bank accounts									-0.045 ***
Not homeowners									-0.054 ***
Has subsidized housing									-0.061 ***
Constant	0.040 **	-0.100 ***	-0.108 ***	-0.112 ***	-0.108 ***	-0.150 ***	-0.152 ***	-0.139 ***	0.094 ***
BIC	29100000	28500000	28300000	28400000	28300000	28100000	28100000	28100000	27900000
	Est SE	Est SE	Est SE	Est SE	Est SE	Est SE	Est SE	Est SE	Est SE

Variance (Age)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Variance (Constant)	0.24	0.02	0.17	0.01	0.15	0.01	0.15	0.00	0.15	0.01	0.15	0.01	0.15	0.01	0.15	0.00	0.15	0.01
Variance (residual)	0.67	0.01	0.67	0.01	0.67	0.01	0.67	0.00	0.67	0.01	0.66	0.01	0.66	0.01	0.66	0.00	0.64	0.01

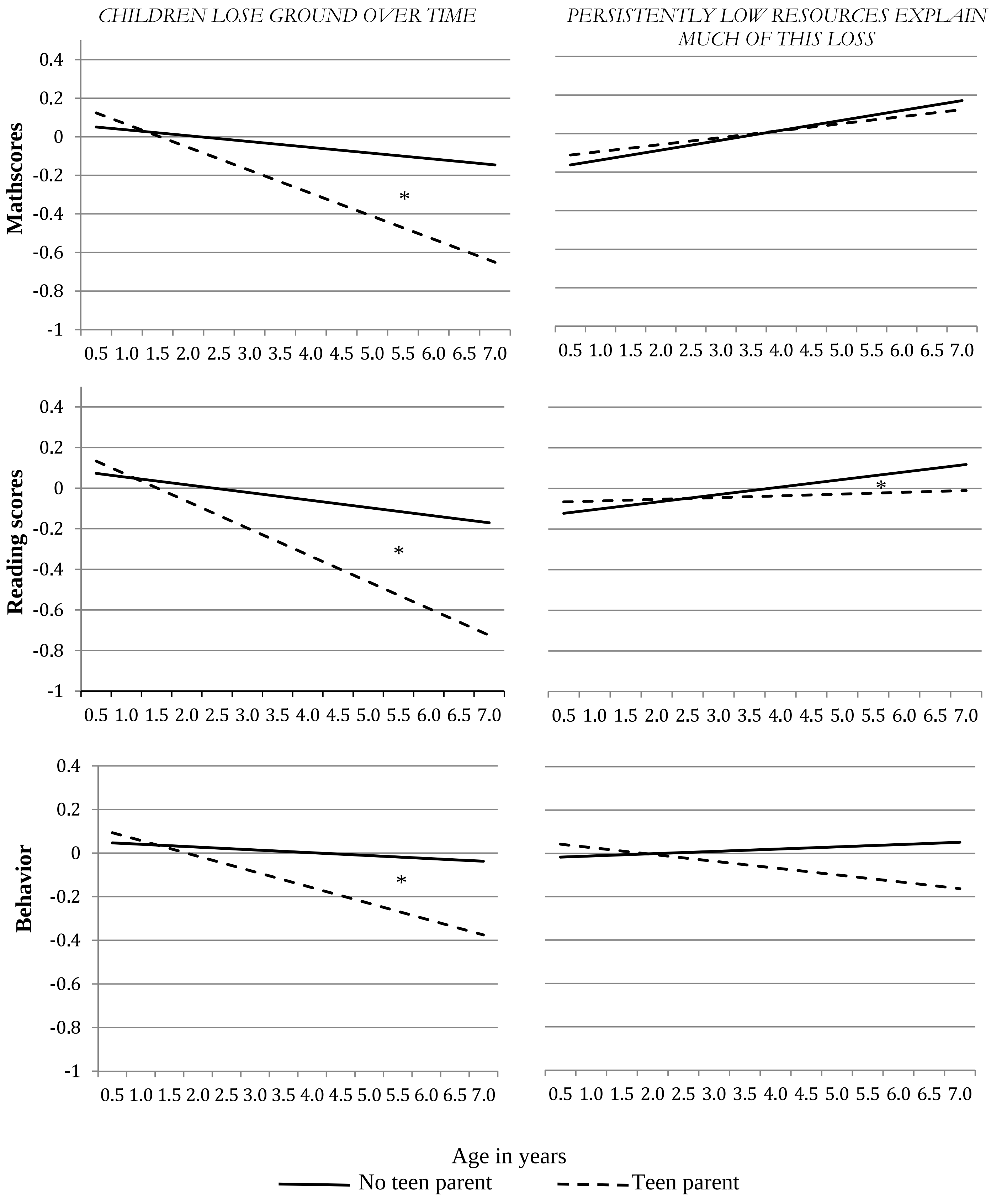
Notes: Source: Early Childhood Longitudinal Study-Birth Cohort, 2001-2007.
N people ≈ 8450 and *N* person-time ≈ 27450. Analyses account for probability weights and clustering. ° 1 = yes. * p<.05 ** p<.01 *** p<.001; two-tailed tests.

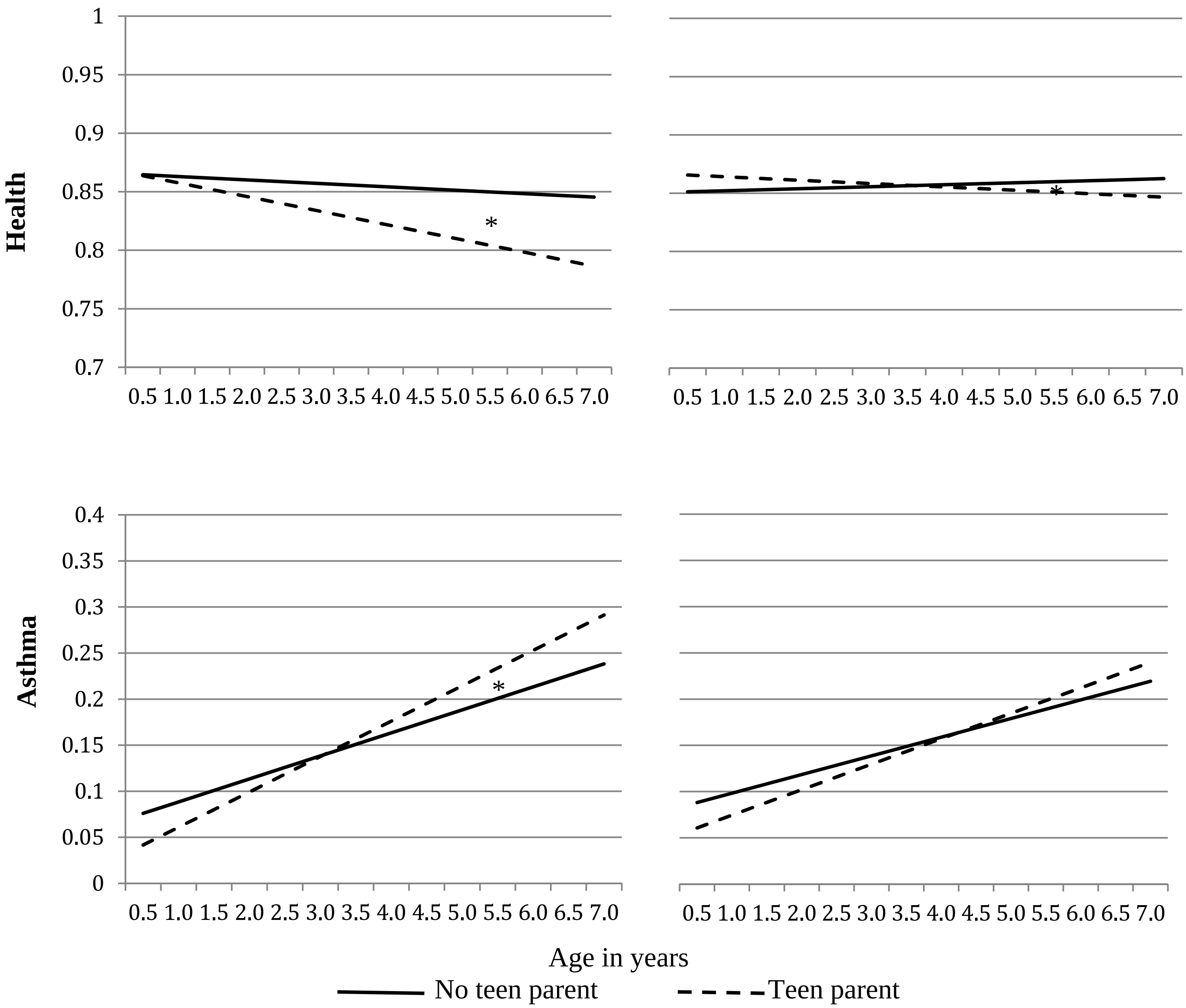
Figure 1. Hypothesized resource dynamics explanations for widening developmental and health disparities between teen parents' children and their peers

Explanation for widening disparities over time	*Resource dynamic*	*Operationalization*
1. Teen parents' children tend to have resources below necessary thresholds for normative development	Nonlinear relationships	Time-varying measure of low resource for each resource type
2. Teen parents' children have concurrently low resources across multiple domains	Multiple domains	Time-varying measure of # domains of low resources at wave
3. Teen parents' children have fewer resources in the critical period of earliest childhood	Time (developmental timing)	Negative child age*resource interactions
4. Teen parents' children have persistently low resources throughout early childhood	Time (duration)	Time-varying measure of # waves to date with a low resource

Note: All explanations use analyses predicting growth curves in development and health, testing whether each explanation mediates the positive interaction of age with teen parent status.

Figure 2. Predicted Growth Curves of Child Outcomes for Typical Hypothetical Cases, by Teen Parent Status, Before and After Mediation by Persistently Low Resources





Source: Early Childhood Longitudinal Study-Birth Cohort, 2001-2005. N≈8450 for cognitive/reading, cognitive/math, and behavior, 8600 for health status and asthma.
Notes: All variables except age and teen parent status are set to zero, which is the mean of the sample. "Before mediation" is equivalent to predicted values from Table 2, Baseline Model; "after mediation" is equivalent to Table 2, Persistently low resources model . * = significant difference between children with and without a teen parent at age 5.5 (typical kindergarten start) at p<.05.

NOTES

[i] Because of ECLS-B confidentiality requirements, all *N*s are rounded to the nearest 50.

[ii] Because we used a growth curve approach, the unit of analysis was person-years rather than individuals, so the analysis sample was 27,900 for reading, 27,850 for math, 29,100 for health and asthma, and 23,500 children for behavior. With each child in the analysis sample providing 2-4 waves of information, the average number of waves per child was 3.3 for reading and math, 3.4 for health and asthma, and 2.9 for behavior.

[iii] The BSF-R was developed by ECLS-B based on the Bayley Scales of Infant Development, Second Edition (BSID-II).

[iv] The (often copyrighted) items from assessments were not available to users of the data, so we relied on scores constructed by ECLS-B staff using item response theory (IRT) modeling.

[v] For the wave 3 measure, we used reports from the early care and education providers (ECEP) when available. Many children who entered kindergarten in wave 5 were in preschool in wave 4, but not wave 3, and thus would not have information from an ECEP provider in wave 3. For these children, we filled in data with the ECEP provider information from wave 4. For children without an ECEP survey in either wave 3 or 4, we filled in the wave 3 behavior outcome with an age-adjusted average of their reports from waves 2 and K.

[vi] The high proportion of reports of favorable child health necessitated this particular dichotomy; for example, only 3% of child health reports at Wave 3 fell into the “fair” or “poor” categories.

[vii] As this question was not asked in the last survey wave, the wave 4 indicator of asthma was filled in for children who did not enroll in kindergarten until wave 5.

[viii] Binary logistic regression has advantages for analyzing a dichotomous outcome, but we argue that they are outweighed by the major disadvantage of not being able to include probability or replication weights to adjust for complex survey design. ECLS-B users are strictly advised to incorporate probability weights in their analyses. Additionally, logistic regression is not suitable for making comparisons across different equations for the same outcome (Mood 2010). Because we must compare equations in order to test for mediation of the widening disparity by teen parent status and because of the need to incorporate weights, we used multilevel models for continuous outcomes.

[ix] The other negative changes were in WIC receipt (for which children have aged out of eligibility at kindergarten start), coresidence with other adults (which prior research has found to be problematic for most children's development; see Mollborn, Fomby, and Dennis 2011), and part-time child care (which appears to have been replaced by full-time child care for most of these children).