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Family Instability and Adolescent Educational Success: The Cumulation and Timing of Family Transitions Across Childhood

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Abstract

Prior research has recognized family instability, separate from family type, as a risk factor for poor educational outcomes, but theoretical elaboration and measurement sophistication have been limited. In particular, cumulation and timing models suggest that the effect of family transitions depend on the age when they occur and that multiple transitions may be particularly detrimental. This study examines the impact of transitions between family types on four end-of-high school outcomes: math and science course taking (specifically, completing Algebra II and chemistry), cumulative grade point average (GPA), and high school completion. I find evidence for the impact of family instability in models of math and science course achievement; all measures (ever a transition, number of transitions, and age of transition) significantly predict whether adolescents pass Algebra II and chemistry, and fit statistics confirm the influence of instability measures relative to a baseline status model. However, few transition measures affect cumulative GPA or high school completion, and none make a significant contribution to model fit. Moreover, I find little evidence that the impact of family instability depends on the number or timing of transitions. Indeed, I find that accounting for any family transition helps to predict course achievement, but that taking into account a history of family instability does not help to explain cumulative indicators of grade achievement or high school graduation. Overall, findings suggest that family transitions may have a greater impact on whether adolescents take college-preparatory courses that become more optional toward the end of the high school career, but may be less likely to derail cumulative processes like grade achievement or graduation that are shaped starting at the beginning of high school.

It is well-known that growing up without both biological parents is negatively related to educational attainment (Biblarz and Raftery 1999; McLanahan and Sandefur 1994). More recently, studies have recognized family instability (i.e., changes between family types), separate from family type (e.g., two biological parents, stepfamily, single parent), as a risk factor for poor educational outcomes, including school dropout, poor academic achievement, and school engagement (Cavanagh, Schiller, and Riegle-Crumb 2006; Heard 2007b; Wojtkiewicz 1993). However, theoretical elaboration, conceptual development, and measurement sophistication of the concept of family instability have been limited. That is, few studies locate family structure histories within a single theoretical framework or explore how to conceptualize or specify an adolescent's experience with family transitions. Moreover, studies that do consider these issues (see Fomby and Cherlin 2007; Hao and Xie 2002) do not focus specifically on the culmination of educational pathways in adolescence.

This project addresses these concerns by examining the impact of transitions between family types on four end-of-high school outcomes: math and science course taking, grade point average (GPA), and high school completion. Specifically, I consider whether the effect of family transitions depend on the age when they occur, and whether adolescents who have experienced multiple transitions are particularly disadvantaged, relative to those who had just one transition or none at all. I draw on perspectives of family instability from stress theory and principles of life course theory emphasizing the cumulation and timing of life events. Using data on nearly 7,000 respondents from Waves I-III of the National Longitudinal Study of Adolescent Health (Add Health) and the Adolescent Health and Academic Achievement Study (AHAA), I examine two research questions: (1) Does family instability, separate from family type, impact math/science

course taking, GPA, and high school completion? (2) Does the impact of family instability depend on the number and timing of transitions?

Theoretical Foundations

I ground the conceptualization of family instability in two theoretical frameworks: stress theory and life course theory. Stress theory (Rutter 1983) argues that a family structure change is an emotionally stressful event for children, involving changes in family routines, disrupted expectations about family life and their futures, and altered relationships to key parent figures (Hetherington, Cox, and Cox 1978; Wallerstein and Kelly 1980). Studies show that family transitions reduce children's psychological, behavioral, and educational well-being (Cavanagh, Schiller, and Riegle-Crumb 2006; Fomby and Cherlin 2007; Heard 2007b; Wojtkiewicz 1993; Wu and Martinson 1993), and the stresses of family instability may have long-term consequences into adulthood (Wallerstein, Lewis, and Blakeslee 2000). One implication is that the type of transition is a less important aspect of family instability (Fomby and Cherlin 2007; Osborne and McLanahan 2007; Wojtkiewicz 1993),[1] since children experience similarly stressful periods after parent divorce or remarriage (Bray 1999; Hetherington, Cox, and Cox 1978). Moreover, the stress model highlights the conceptual distinction between family structure and family instability (see Brown 2006); family structure is a snapshot measure of available parental resources, but cannot address how well children adapted to that family type, while family instability is a long-term indicator of stress exposure.

While stress theory highlights the family processes that expose children to stressors, the developmental context is likely to impact how children adapt to stressful events, by shaping their coping strategies and resources (Rutter 1983). Life course theory argues that the impact of life

[1] Brown (2006) is an exception, finding that the transition from a two-parent to a single-mother family has no impact on adolescent well-being, while entering a two-parent family is associated with increases in delinquency and declines in school engagement.

events depends on the developmental stage and social context within which the events occur. This theory sees individual lives as *trajectories*, which are the chains of social states along a particular social pathway over a period of the life span (Elder 1998). Family structure can be viewed as a trajectory from birth through adolescence, with each family type constituting a stage along the trajectory and transitions as the movements between these stages. In this way, life course theory addresses the developmental processes throughout childhood that can condition the influence of stressful family transitions on adolescent educational outcomes.

Family Instability and the Life Course

Two life course concepts are relevant when conceptualizing the stressful impact of family instability on adolescent educational development. First, *the cumulation of disadvantage* is the "concatenation of negative events and influences" (Elder 1998) and posits that the negative consequences of life events can accumulate over time. Cumulative risk theory argues that multiple stressors during childhood make children particularly vulnerable (Morales and Guerra 2006; Sameroff, Seifer, Barocas, Zax, and Greenspan 1987), suggesting that the influence of family instability will compound with increasing frequency of transitions. Studies of younger children's cognitive and behavioral outcomes find little evidence that multiple, versus single, family transitions are particularly disruptive (Carlson and Corcoran 2001; Osborne and McLanahan 2007), but research has not focused on older adolescents who are more likely to have accumulated multiple transitions.

Second, the principle of *timing in lives* argues that "the developmental impact of a succession of life transitions or events depends on when they occur in a person's life" (Elder 1998), suggesting that the influence of a family transition is likely to depend on the life stage in which it occurs. Although there may be no optimal age, a family transition in early childhood can

be particularly disruptive. Young children are less able to psychologically process the event and have fewer sources of nonfamily support (Hetherington, Camara, and Featherman 1983). Studies show that early family transitions have particularly negative effects on school outcomes (Ermisch, Francesconi, and Pevalin 2004; Heard 2007b). However, Garmezy (1983) argues that there may be a significant amount of recovery after a disruption if children have time to adapt to changing circumstances, suggesting that later transitions may be most influential. Indeed, Wu and Martinson (1993) find that the risk of a nonmarital birth is highest soon after a family change and declines steadily over several years.

Educational Development In High School

This study focuses on adolescent educational success because it is one of the most salient predictors of adult status attainment (Astone and McLanahan 1991; Sewall and Shah 1968). But education is not just about learned knowledge; it is relevant to family and life course studies because it is also a developmental pathway (Pallas 2003). Education is a trajectory through which children accumulate skills and behaviors as they navigate the educational system, such as intellectual development, achievement values, and prosocial norms (Astone and McLanahan 1991; Biblarz and Raftery 1999; Sewall and Shah 1968), which contribute to positive development in adulthood (Csikszentmihalyi and Schneider 2000; Mirowsky and Ross 2003).

The outcomes examined in this project, math and science course taking, cumulative GPA, and high school completion, are end-of-high-school assessments summarizing the secondary education pathway, and are likely to be directly influenced by a history of family instability. Math and science courses are standardized across American high schools and cumulative within a curricular hierarchy in which students progress from less advanced to more advanced courses (Schneider, Swanson, and Riegle-Crumb 1998). By disrupting adolescents' trust in their abilities

and their futures, and impeding parents' ability to monitor school progress, family transitions may slow progression through the hierarchy. Consequently, the impact of family instability is likely to be strongest at the end of the academic trajectory. Cavanagh (2006) found that the number of family transitions was associated with math course level at the end of high school, when advanced courses are optional, but not in 9th grade when math is still required. Multiple transitions may be particularly detrimental by making students fall further behind in a hierarchical process in which it is difficult to recover. Also, early family disruptions may impede the development of fundamental cognitive skills and social behaviors that are likely to reduce math and science success in adolescence (Rimm-Kaufman and Pianta 2000).

In addition, grade achievement reflects academic skills, a capacity to meet externally imposed standards, and adherence to prosocial norms of achievement (Astone and McLanahan 1991; Hill, Castellino, Lansford, Nowlin, Dodge, Bates, and Pettit 2004), and is negatively impacted by family instability (Heard 2007b). Overall GPA is a cumulative indicator of achievement at the end of high school and is an assessment of the student's high school career and position in the school hierarchy. Thus, each successive family disruption can cause a permanent deficit that cannot be erased, and multiple disruptions may lead a student to disengage from achievement norms. In terms of timing, both early and late transitions may lead to reduced grade achievement. Gaps in early childhood learning can become consequential as courses become more rigorous in high school, although research shows that recent transitions in adolescence contribute to significant declines in GPA (Heard 2007a).

Finally, academic progress and achievement culminate in the end point of the secondary education trajectory: high school completion. Dropping out of school is the end result of a process of school disengagement, in which students progressively detach themselves from the

goals, attitudes, and behaviors intrinsic in the educational process (Astone and McLanahan 1991). The stress of family instability contributes to school disengagement (Heard 2007b), while associated disruptions, such as a residential move or increased family responsibilities, may make it more difficult to stay in school (Astone and McLanahan 1994). Because school failure is the ultimate indicator of school disengagement, there may be a threshold number of transitions that must be reached before adolescents drop out. In terms of timing, transitions in adolescence may have a more direct and immediate impact by distracting adolescents from school needs, bringing new family responsibilities with competing demands on their time and leading to family conflict that may culminate in the teen leaving the parental home (Goldscheider and Goldscheider 1989).

Data and Methods

Data

Data come from three waves of Add Health, a nationally representative, multiwave study of adolescents with a multistage, stratified, school-based, cluster sampling design (Harris, Florey, Tabor, Bearman, Jones, and Udry 2003) and the AHAA supplemental transcript study (Riegle-Crumb, Muller, Frank, and Schiller 2005).[2] An in-school questionnaire was administered to every student in a sampled high school or junior high/middle school in one of 80 communities in 1994-1995 (*N*=90,118). A random sample of adolescents was selected for in-home interviews in 1995 (Wave I, *n*=20,745), along with a resident parent, generally the mother (*n*=17,700). Subsequent interviews were conducted in 1996 (Wave II, *n*=14,738), and in 2001-2002 (Wave III, *n*=15,197) when respondents were ages 18-26. At Wave III, 13,901 respondents also had retrospective data collected on their high school transcripts for the AHAA study, which can be

[2] Udry and Chantala (2003) find that Add Health is not biased by adolescents who dropped out before the in-school data collection.

linked to the Add Health data. The final sample size for this study includes 6,936 respondents.[3] The analytic sample includes all respondents with data from all three waves of Add Health and AHAA who had valid sampling weights; were in 7th-11th grades at Wave I; had valid family structure histories (i.e., had a parent interviewed who was a resident of the adolescent's home and no discrepancies between adolescent and parental reports); and had valid education histories (high school transcripts could be matched to Add Health data and first year of course-taking data corresponds to 9th grade year).

Measures

Educational outcomes. All data on outcome measures are taken from the AHAA transcript data, based on final achievements by 12th grade. Math/science course sequences come from standardized CSSC (Classification of Secondary School Curriculum) classifications of all courses taken within each subject.[4] Course-taking indicators are based on AHAA-constructed measures of the highest course taken, and highest course passed for credit, across all high school years in math (no math, basic/remedial math, general/applied math, pre-algebra, algebra I, geometry, algebra II, advanced math, pre-calculus, and calculus) and science (no science, basic/remedial science, general/health science, biology, chemistry, advanced science, physics). Following prior studies of math and science course taking (Cavanagh, Schiller, and Riegle-Crumb 2006; Riegle-Crumb, Muller, Frank, and Schiller 2005; Schneider, Swanson, and Riegle-Crumb 1998), I focus on indicators of achievement in key college preparatory courses by creating indicators of whether the respondent passed *Algebra II* and *chemistry* for credit. In addition, I examine grade achievement across high school with an indicator of *overall cumulative*

[3] 12th graders are dropped to ensure that family structure measures occur before the end-of-high-school outcomes.
[4] The CSSC classifications in AHAA have been used in prior education studies such as the National Education Longitudinal Study of 1988 and the National Assessment of Educational Progress High School Transcript Studies (Ingels, Dowd, Taylor, Bartot, Frankel, and Pulliam 1995; Legum, Caldwell, Davis, Haynes, Hill, Litavecz, Rizzo, Rust, and Vo 1997).

GPA, calculated for all courses taken across all years of high school; GPA is coded on a four-point scale, with A=4 to F=0. Finally, I examine whether the adolescent *completed high school* (e.g., received standard, honors, or special education diploma) or did not complete high school (i.e., dropped out, earned a general equivalency diploma, or other non-graduate).[5]

Family structure. Retrospective family structure data come from: (a) adolescents' reports of type of and duration lived with residential parents, (b) residence histories with nonresidential parents, and (c) resident parents' reports of their marriage and cohabitation histories. These data were compiled into seven-category family structure indicators for each year of the adolescent's life, measured from birth (age 0) until the Wave II interview (Wave I for 11th graders): two original (biological or adoptive) parents, married mother-stepfather, cohabiting mother-stepfather, married father-stepmother, single mother, single father, and nonparents (generally relatives or foster families).[6]

I use these yearly indicators to construct measures of the family structure history. I start with measures of family instability. First is a dichotomous indicator of whether the adolescent *had any family transition* (1=yes, 0=no). Alternate specifications derive from disaggregating those who ever had a transition. I include a cumulative measure of the *number of transitions* (three dummy indicators of one, two, or three or more changes) and timing indicators of the *age*

[5] I include those who received GED's with non-graduates because prior research shows that GED recipients are indistinguishable from high school dropouts in terms of overall educational attainment (Cameron and Heckman 1993).

[6] I followed several rules when constructing these variables: Adolescents living with two biological parents are presumed never to have lived with any other parent figure; adolescents in stable two-parent adoptive families are included with biological parents; adolescents could not live with both original parents after their relationship ended; a stepparent must be the spouse or partner of an original parent with whom the adolescent lives (e.g., an adolescent could not live with a stepfather if she or he was not living with the mother); and nonparents are residential adults whom the adolescent listed as "like a father" or "like a mother," only if there is no biological or adoptive parent in the home. These are likely to be highly involved nonparents, so results may underestimate the effect of living in this family type. Inconsistencies in family structure histories are resolved by prioritizing the report of the resident parent, then the adolescent, then the resident nonparent. In 3% of cases, there is at least one year with missing family structure information. Changes are only recorded, however, between years with valid information. Reliability checks show that exposure measures are not biased by this small amount of missing data.

when a family transition occurred: young childhood (birth to age 6), middle childhood (ages 7 - 11), or adolescence (age 12 or older).[7] For all three instability measures, the reference category is adolescents who never experienced a family transition.[8] As a control for the beginning of the family structure trajectory, I also created a measure of initial family status. Adolescents who lived with two biological parents or two adoptive parents up to age 1 are considered to live in a *two-parent family at birth*.[9]

Control variables. Race/ethnicity is a categorical variable indicating White non-Hispanic (reference), Mexican American, other Hispanic, Black, Asian, and some other race. I also control for gender (female=1, male=0), adolescent's age at Wave I, parent's age at adolescent's birth, and family income. Verbal ability is measured with the Add Health Picture Vocabulary Test, an abridged version of the Peabody Picture Vocabulary Test. Parental education (less than high school, high school graduate, some college, college graduate) represents the highest level of education among all resident parental figures. I also include school-level indicators of urbanicity (suburban [reference], urban, rural) and school type (private=1, public=0). Finally, I include indicators of school achievement in 9th grade (math course level, science course level, GPA) in models predicting Algebra II, chemistry, and cumulative GPA, respectively. Table 1 shows descriptive statistics of all variables used in this study.

Analytic Strategy

[7] Adolescents who had more than one transition were assigned to a category based on their most recent transition. For example, respondents who experienced transitions in middle childhood and adolescence were coded as having an adolescent transition.

[8] Preliminary models included a dummy indicator for 7th and 8th graders in early adolescence (14 and younger) to determine if their shorter exposure creates downward bias on effects of the timing measure. This dummy indicator was not significant in any model predicting any outcome, and is not included in final models.

[9] Additional models (not shown) included seven category measures of family structure type in adolescence. Substantive conclusions about impact of timing measures were not changed, and measures of family type at the end of the family structure trajectory may be correlated with a history of instability. Results are available upon request.

Data are analyzed using logistic regression (Algebra II, chemistry, high school completion) and ordinary least squares regression (cumulative GPA). Analyses use weighted *svy* commands in STATA to adjust for the complex survey design (Chantala 2006; StataCorp 2003). Missing values are substituted using the *impute* command in STATA.[10] For each outcome, I include two indicators of model fit: R^2 (for OLS regression) and log likelihood (for logistic regression), and Bayesian Information Criterion (BIC) statistic (Raftery 1995). The BIC statistic is calculated as $df(\ln N) - \chi^2$, where *df* is the degree of freedom associated with each model, *N* is the sample size, and χ^2 is the likelihood ratio of the estimated model relative to a null model with no covariates. More negative BIC values indicate a better model fit than less negative BIC values. I rely on the BIC statistic for model selection for two reasons (Raftery 1995; Teachman 2003). First, the BIC adjusts for large sample sizes. Traditional tests of model fit such as the log likelihood statistic are heavily influenced by sample size, and it can be difficult to reject ill-fitting models as sample size increases. Second, the BIC allows for comparison of non-nested models, allowing me to compare the influence of different specifications of family instability.

Selection bias is a common concern in family structure research, although evidence of substantial bias is mixed (Cherlin, Chase-Lansdale, and McRae 1998; Hao and Xie 2002; McLanahan and Sandefur 1994). While no study can completely eliminate selection bias, this study follows the model of Hao and Xie (2002) by addressing the issue on multiple fronts. First, the longitudinal research design may account for any prior selection into family types before adolescence. Second, repeated measures of math/science courses and GPA at the beginning and end of high school can address prior child outcomes and unmeasured child characteristics, while providing comprehensive indicators of the high school educational trajectory. Finally, the control

[10] I include flags for imputed values of verbal ability (4%), family income (11%), parent's age at adolescent's birth (<1%), and 9th grade GPA (<1%). The addition of these flags does not change overall patterns of results in any model.

for verbal ability is a stable child characteristic that captures a child's innate predisposition to develop learning skills (Holden 1990; Moore and Snyder 1991). Moreover, because the cognitive abilities of parents and children are highly correlated and composed of both genetic and environmental influences (Moore and Snyder 1991; Plomin 1989), it is possible that this measure helps to account for some unmeasured family factors that contribute to family instability and educational development.

Results

Dimensions of the Family Structure Trajectory

I begin by describing the family structure trajectories of adolescents in the sample. Table 2 shows the percentages of adolescents along various indicators of the family structure trajectory throughout childhood by family status at birth. This table shows how a child's origins are related to the amount of instability and types of parental relationships they are likely to experience by adolescence. The top panel shows family status types in adolescence, as of the Wave II interview (Wave I for 11^{th} graders). Children born into two parent families are much more likely to live with either biological or adoptive parents by adolescence than are children born into single parent families (73.73% vs. 2.57%). This small percentage of children born to single parents may have parents who married or began cohabiting since their birth. About 13% of those born to two parents now live with a single mother. In contrast, adolescents born to single parents are much more likely to live in more diverse family types. For example, almost 44% of children born to single parents reside with a single mother as adolescents, while nearly 27% have transitioned to living with a married mother and stepfather, and more than 9% reside with no parental figures.

Indicators of family instability provide more information about the family experiences of these adolescents throughout their lives. Almost three quarters of adolescents born to single parents have experienced a family transition, although more than one quarter of those living with two parents at birth will also face a family disruption. However, these adolescents are much more likely to have had only one transition, while teens born to single parents are as likely to have gone through two family changes as to experience only one. Finally, measures of the timing of family change suggest that transitions are more common in adolescence for both groups, although children born to single parents are more likely to experience transitions at every developmental stage. This table suggests that children who are born into different family types, distinguished by the number of available parents, are likely to diverge even more as they progress along the family structure trajectory during childhood, but that instability is not uncommon even for those starting life.

Bivariate Relationships Between Family Structure and Educational Outcomes

Table 3 shows means and percentages of the four educational outcomes, by each family structure measures. The top rows show that adolescents who were born to two biological or adoptive parents were more likely to have passed Algebra II and chemistry, completed high school, and earned higher grades than adolescents from other types of families. In terms of family instability, having ever experienced a family disruption is also negatively associated with educational outcome. Bivariate results suggest that family instability is correlated with educational development. While ever facing a transition is associated with poorer academic achievement and attainment than living in a stable family throughout childhood, having two transitions, or three or more, is associated with being less likely to pass Algebra II and chemistry, and earning lower grades, relative to only one transition. In addition, transitions during middle childhood are

associated with fewer negative consequences, relative to family structure changes in early childhood or in adolescence. A family change in adolescence is related to a lower chance of passing Algebra II, of completing high school, and lower GPA, while an early family change is associated with lower grade achievement relative to transitions in middle childhood.

Multivariate Models

While the previous tables demonstrate the complexity of family trajectories and suggest that aspects of family instability have differential impacts on indicators of educational development, one cannot fully understand the impact of family transitions without accounting for the beginning of the family structure trajectory and for control measures. I now turn to tables showing multivariate models predicting each indicator of educational development. Each table includes a baseline model showing the effect of family status at birth on each outcome, adjusted for control measures. Subsequent models add each family instability indicator (ever had a transition, number of changes, timing of transitions), and I compare effects of dummy cumulation and timing indicators using the *lincom* command in STATA (StataCorp 2003). Assessment of model fit is done by comparing transition models to the baseline model using BIC statistics. Effects of control measures are shown in multivariate tables, but are not discussed.

Table 4 presents the results of logistic regression models, showing the log odds of taking Algebra II or higher course. Model 1 shows that adolescents born into two parent families were 29% more likely to take Algebra II relative to those born into a single parent family. The next three models show different specifications of transition models. I find that having a family history of instability eliminates the early advantage associated with being born into a two-parent family; specifically, all indicators of family instability have significant and negative effects on math course achievement. Ever having a family disruption (Model 1) is associated with a 31%

reduction (OR=.69) in the odds of completing Algebra II, while having one, two, or at least three transitions are associated with odds ratios of .76, .62, and .59, respectively. The timing model shows that all transitions negatively impact the odds of passing Algebra II by the end of high school, with odds of .66 for an early childhood transition, .72 for a transition in middle childhood, and .69 for a transition in adolescence. However, I find no evidence that the number or timing of family changes moderate the impact of instability on math course achievement. That is, effects of having two, three, or more family transitions is not associated with a greater impact on the likelihood of taking Algebra II, and having a family transition in adolescence is not significantly different from a family transition in early childhood or middle childhood. BIC statistics associated with each model indicate that all three-transition models fit the data better than the baseline status model, generating more negative BIC values. Comparing the fit between Model 2 (BIC = -2544), Model 3 (BIC = -2531), and Model 4 (BIC = -2527) indicates that Model 2, the simple dichotomous indicator of whether the adolescent ever had a family disruption, best predicts math course achievement.

Table 5 shows similar models predicting the log odds of passing chemistry in high school. The influence of family structure at birth on science course achievement is somewhat greater than the effect on math course achievement; adolescents born into two parent families are more than 50% more likely to pass chemistry. Controlling for a history of family transition reduces this effect, but even adolescents who later experience a family disruption still benefit from having two parents at birth. Ever facing a family transition is associated with an 18% decrease in the likelihood of passing chemistry in high school (Model 2). Interestingly, the cumulation model (Model 3) shows that adolescents who experienced two transitions are significantly less likely to pass chemistry, relative to those experiencing one transition or to those

from stable families; indeed, no other indicator of the number of transitions is significantly related to science course achievement. Finally, Model 4 shows that an early childhood transition reduces the likelihood of completing chemistry in high school by 30%. Similar to Table 4, BIC statistics show that the most parsimonious transition model, indicating a history of any family disruption (BIC = -1257), fits the data better than the cumulation (BIC = -1247) or timing (BIC = -1243) models and slightly better than the baseline status model (BIC = -1256).

Next, Table 6 shows results of OLS regression models predicting cumulative GPA at the end of high school. In contrast to models predicting math and science course taking, the impact of family structure indicators are relatively small and generally nonsignificant. I find no significant effects of living in a two-parent family at birth (Model 1), ever having a family disruption (Model 2), or the number of family disruptions (Model 3). Only an early childhood transition significantly reduces cumulative GPA (Model 4) and only by .05 grade points. Regardless, BIC statistics indicate that the baseline status model best fits the data (BIC = -11800) relative to the transition models (BIC = -11795 for Model 2, -11780 for Model 3, and -11784 for Model 4).

Finally, Table 7 shows the effects of models predicting high school completion. In Model 1, a two-parent family at birth is associated with a 39% increase in the odds of completing high school relative to those born into a single parent family. Family structure at birth continues to significantly impact educational attainment even after controlling for whether the adolescent ever had a family transition (Model 2) or for the timing of family transitions (Model 4). Only cumulation measures have any significant impact on attaining a high school diploma; experiencing two family transitions reduces the likelihood of graduating from high school by 30% (Model 3). However, much like the models predicting cumulative GPA, the model just

including the indicator of family status at birth fits the data better (BIC = -309) than models including indicators of a history of any family disruption (Model 2, BIC = -304), number of family transitions (Model 3, BIC = -290), or the timing of family transitions (Model 4, BIC = -293).

Conclusion

This project sought to investigate the role of family instability in shaping adolescents' educational pathways throughout high school. I examined the family structure and transition experiences of a sample of children who were in adolescence in the mid-1990 and predicted how successfully they navigate the educational pathway in high school. This project specifically focused on examining whether accounting for family instability helps to explain educational development beyond the impact of family type. I also test two hypotheses regarding the conceptualization of family instability, based on life course theory: the cumulation hypothesis, that the negative impact of family transitions is likely to compound with the number of transitions; and the timing hypothesis, that the impact of a transition is dependent on the life stage in which it occurs.

I find significant direct effects of family instability across all models. All indicators of the ever transition, cumulation, and timing models are significantly related to taking Algebra II, and the indicator of ever transition, two transitions, and an early family change all significantly predict taking chemistry. BIC statistics suggest that the parsimonious indicator of family instability, ever having a family disruption, best predicts math and science course achievement. In contrast, I only find evidence that the timing of family instability, specifically an early childhood transition, has any impact on cumulative GPA, while experiencing two family changes

is the only instability measure related to high school completion. However, these effects on grade achievement and graduation are relatively small; BIC statistics confirm that transition measures do not contribute significantly to model fit, and the baseline model of family status at birth is sufficient to estimate the influence of family structure on these outcomes.

These results suggest that family influences work differently on adolescents' progression through hierarchical course sequences than on measures of school achievement and attainment. As math and science course taking becomes more optional toward the end of high school, family instability may have increased influences on completion of college preparatory courses such as Algebra II and chemistry, which are likely to be taken at the end of the high school career (Cavanagh, Schiller, and Riegle-Crumb 2006). In contrast, overall indicators of school success such as grade achievement and high school graduation are the culminations of processes that begin in 9th grade, and transitions may be less likely to derail children from the course that was established early in high school. A contribution of this study is to operationalize education as a developmental pathway, which helps to illuminate the different institutional processes that come together to shape family influences on school outcomes.

Although I hypothesized that the cumulation or timing of family instability may shape its impact on educational development, I find little support for this argument. Accounting for the number of family transitions, or the life stage in which they occur, does not improve model fit over more parsimonious models. The lack of evidence for the cumulation and timing models contrasts with findings from Heard (2007b), which showed that early family changes, especially mother changes, had stronger influences on indicators of college expectations and suspension/expulsion. Findings are more consistent with Wojtkiewicz (1993), who found that more parsimonious family structure models best predicted high school graduation. It may be that

the educational pathway, which is the culmination of all the years adolescents spent in high school, is less responsive to a family transition than are one-time indicators of attitudes and behavior problems, which can act as immediate barometers of children's responses to family stressors.

At the very least, these results highlight the fact that the family status that children are born into is highly predictive of their family structure experiences throughout their lives. Children who are born to a single parent are much more likely to experience a family transition at some point in their lives, as indicated in Table 2. Moreover, family status at birth has an independent influence on science course achievement and high school completion, suggesting that the circumstances surrounding a child's birth continue to shape their development and achievement well into adolescence. Unfortunately, Add Health begins well after the respondents' birth, but future research using other data sets should consider assessing indicators of the beginning of the family structure trajectory, as well as experiences that occur throughout childhood.

There are some limitations to this study that should be addressed. First, although the AHAA data provide a rich collection of information on academic experiences in high school, there are few objective indicators of academic performance and opportunities from any time before high school. Given what is known about the importance of early school experiences for later academic success and attainment (Rimm-Kaufman and Pianta 2000), future studies should incorporate academic records from all stages of children's school careers. Second, because many older respondents were interviewed when they were already in high school, this study did not include measures of family processes or adolescent adjustment from Wave I. Prior research highlights how family instability weakens family processes and social supports that encourage

academic achievement (Cavanagh, Schiller, and Riegle-Crumb 2006; Heard 2007a), and future studies should explore these explanations further. Finally, there may still be selection bias due to the processes that shape family structure experiences by adolescence. Using detailed longitudinal measures of family structure history and controlling for stable characteristics such as cognitive ability, likely reduce bias resulting from the endogeneity of family structure and adolescent well-being, but unmeasured characteristics of parents and children still may influence both processes. However, studies that explicitly account for selection bias have reached divergent conclusions, with some suggesting that selection inflates estimates of family structure effects (Cherlin, Chase-Lansdale, and McRae 1998), others showing that the influence of family structure actually increases after accounting for selection (Hao and Xie 2002), and still others finding little evidence of selection bias (McLanahan and Sandefur 1994). Although these studies contribute to our understanding of the processes leading to family composition, many questions remain concerning the nature of the relationship between family structure and child well-being.

Table 1. Means and Percentages, Weighted Sample Characteristics.		
Variable	Percentage	Mean (Standard Deviation)
Educational Outcomes		
Math course (Algebra II)	61.17	
Science course (Chemistry)	65.40	
Cumulative GPA		2.59 (.03)
High school completion	89.96	
Family Structure		
Family structure at birth:		
Single parent	18.79	
Two biological/ adoptive parents	81.21	
Ever had family transition:		
No *(ref)*	64.96	
Yes	35.04	
Number of family transitions:		
No transitions *(ref)*	64.96	
One transition	18.58	
Two transitions	11.29	
Three or more transitions	5.167	
Timing of family transitions:		
No transitions *(ref)*	64.96	
Early childhood transition	7.51	
Middle childhood transition	9.34	
Adolescent transition	18.19	
Adolescent Characteristics		
Race/ ethnicity:		
White non-Hispanic *(ref)*	71.41	
Mexican American	5.36	
Other Hispanic	5.09	
Black	14.13	
Asian	3.23	
Some other race	0.78	
Female	50.06	
Age at Wave I		14.83 (.11)
Verbal ability		102.89 (.55)
Missing	4.44	
Household Demographics and SES		
Young sibling (less than 6 years old)	10.15	
Parent's age at adolescent's birth		26.34 (.14)
Missing	0.68	

Parental education:

Table 1. Means and Percentages, Weighted Sample Characteristics.		
Variable	Percentage	Mean (Standard Deviation)
Less than high school *(ref)*	10.57	
High school graduate	30.3	
Some college	22.16	
College graduate	36.97	
Family income		46.94 (1.59)
Missing	10.98	
Academic Status		
Ninth grade math course level		3.71 (.05)
Ninth grade science course level		2.28 (.05)
Ninth grade GPA		2.61 (.03)
Missing	0.69	
School Characteristics		
Urbanicity:		
Suburban *(ref)*	58.19	
Urban	25.19	
Rural	16.62	
Private school	7.06	

Table 2. Dimensions of Family Structure Trajectory: Percentages of Indicators of Family Instability by Adolescence, by Family Status at Birth.

	Single Parent Family at Birth	Two Parent Family at Birth
Family Status in Adolescence:		
Two biological/ adoptive parents	2.57	73.73
Married mother-stepfather	26.93	7.78
Cohabiting mother-stepfather	4.41	1.35
Father-stepmother	6.63	1.27
Single mother	43.71	12.96
Single father	6.37	1.40
Nonparents	9.37	1.51
Ever had family disruption	71.63	26.57
Number of family transitions:		
One transition	27.00	16.63
Two transitions	26.99	7.66
Three or more transitions	17.64	2.28
Timing of family transitions:		
Early childhood transition	12.82	6.28
Middle childhood transition	16.49	7.69
Adolescent transition	42.33	12.60

All comparisons between adolescents born into two parent family and adolescents born into single parent families are statistically significant based on t-tests, $p<.001$.

Table 3. Means (SD) / Percentages of Educational Outcomes, by Family Structure Measures.

	Algebra II	Chemistry	Cumulative GPA	High School Completion
Family structure at birth:				
Other families *(ref)*	45.71	49.63	2.20 (.05)	82.64
Two biological/ adoptive parents	64.71***	69.02***	2.68 (.03) ***	91.65***
Ever had family disruption:				
No *(ref)*	65.93	69.47	2.71 (.03)	91.82
Yes	52.32***	57.83***	2.39 (.04) ***	86.52***
Number of family transitions:				
No transitions *(ref)*	65.93	69.47	2.71 (.03)	91.82
One transition	56.45***	61.76***	2.44 (.04)***	88.21**
Two transitions	49.82***[a]	53.55***[a]	2.34 (.06)***[a]	84.57***
Three or more transitions	42.83***[a]	53.19***[a]	2.31 (.05)***[a]	84.71**
Timing of family transitions:				
No transitions *(ref)*	65.93	69.47	2.71 (.03)	91.82
Early childhood transition	53.97***	56.86***	2.38 (.07)***	87.16*
Middle childhood transition	55.93***	60.17**	2.52 (.05)***[b]	90.55
Adolescent transition	49.79***[c]	57.03***	2.32 (.04)***[c]	84.17***[c]

Superscripts indicate significant group comparisons based on t-tests: [a]significant difference from one transition, $p<.05$; [b]significant difference from early childhood transition, $p<.05$; [c]significant difference from middle childhood transition, $p<.05$.
*p<=.05 **p<=.01 ***p<=.001 (significantly different from reference category)

Table 4. Logistic Regressions Predicting Math Course Achievement: Completing Algebra II or Higher Math Course by End of High School.

	Model 1	Model 2	Model 3	Model 4
Two parent family at birth	1.29*	1.12	1.07	1.12
Ever had family disruption		.69***		
Number of family transitions: *(none)*				
One transition			.76*	
Two transitions			.62***	
Three or more transitions			.59**	
Timing of family transitions: *(none)*				
Early childhood transition				.66*
Middle childhood transition				.72**
Adolescent transition				.69**
Race/ ethnicity: *(White non-Hispanic)*				
Mexican American	1.19	1.15	1.15	1.15
Other Hispanic	1.30	1.30	1.29	1.29
Black	1.32	1.35	1.34	1.35
Asian	2.09*	2.09*	2.07*	2.09*
Some other race	1.16	1.20	1.18	1.20
Female	1.55***	1.56***	1.56***	1.56***
Age at Wave I	.98	.98	.99	.98
Verbal ability	1.04***	1.04***	1.04***	1.04***
Missing	1.36	1.34	1.33	1.34
Parent's age at adolescent's birth	1.01	1.01	1.01	1.01
Missing	.65	.65	.65	.65

Table 4. Logistic Regressions Predicting Math Course Achievement: Completing Algebra II or Higher Math Course by End of High School.

	Model 1	Model 2	Model 3	Model 4
Parental education: *(Less than high school)*				
High school graduate	1.23	1.21	1.21	1.21
Some college	1.74***	1.71***	1.71***	1.71***
College graduate	2.22***	2.18***	2.18***	2.18***
Family income	1.00*	1.00*	1.00*	1.00*
Missing	1.25***	1.21	1.21	1.21
Ninth grade math course level	2.75***	2.77***	2.77***	2.77***
Urbanicity: *(Suburban)*				
Urban	.91	.92	.92	.92
Rural	.85	.83	.83	.83
Private school	1.21	1.20	1.20	1.20
Log Likelihood	-3256.07	-3241.89	-3239.39	-3241.75
BIC`	-2524	-2544	-2531	-2527

p<=.05 **p<=.01 ***p<=.001

Table 5. Logistic Regressions Predicting Science Course Achievement: Completing Chemistry or Higher Math Course by End of High School.

	Model 1	Model 2	Model 3	Model 4
Two parent family at birth	1.52***	1.41***	1.37***	1.42***
Ever had family disruption		.82*		
Number of family transitions: *(none)*				
One transition			.91	
Two transitions			.68***[a]	
Three or more transitions			.83	
Timing of family transitions: *(none)*				
Early childhood transition				.70*
Middle childhood transition				.82
Adolescent transition				.89
Race/ ethnicity: *(White non-Hispanic)*				
Mexican American	1.31	1.29	1.29	1.28
Other Hispanic	2.36***	2.36***	2.34***	2.36***
Black	1.81**	1.82**	1.82**	1.81***
Asian	3.89***	3.91***	3.86***	3.90***
Some other race	.61	.62	.62	.63
Female	1.50***	1.50***	1.50***	1.51***
Age at Wave I	.97	.97	.97	.97
Verbal ability	1.05***	1.05***	1.05***	1.05***
Missing	.90	.89	.88	.89
Parent's age at adolescent's birth	1.01	1.01	1.01	1.01
Missing	.34**	.35**	.34**	.34**
Parental education: *(Less than high school)*				

Table 5. Logistic Regressions Predicting Science Course Achievement: Completing Chemistry or Higher Math Course by End of High School.

	Model 1	Model 2	Model 3	Model 4
High school graduate	1.23	1.22	1.22	1.23
Some college	1.57**	1.56**	1.56**	1.57**
College graduate	2.44***	2.42***	2.41***	2.44***
Family income	1.01**	1.01**	1.01**	1.01**
Missing	1.36*	1.34*	1.34*	1.35*
Ninth grade science course level	1.60***	1.59***	1.59***	1.60***
Urbanicity: *(Suburban)*	.85	.86	.86	.86
Urban	1.05	1.04	1.04	1.04
Rural	1.88*	1.88*	1.88*	1.89*
Private school				
Log likelihood	-3712.43	-3707.73	-3703.66	-3705.83
BIC`	-1256	-1257	-1247	-1243

Superscript [a] indicates significant group comparison from one transition based on t-tests, p<.05.
p<=.05 **p<=.01 ***p<=.001

Table 6. OLS Regressions Predicting Cumulative GPA by End of High School.				
	Model 1	Model 2	Model 3	Model 4
Two parent family at birth	.04	.03	.03	.03
Ever had family disruption		-.02		
Number of family transitions: *(none)*				
One transition			-.02	
Two transitions			-.02	
Three or more transitions			.01	
Timing of family transitions: *(none)*				
Early childhood transition				-.05*
Middle childhood transition				.00
Adolescent transition				-.02
Race/ ethnicity: *(White non-Hispanic)*				
Mexican American	.04	.04	.04	.04
Other Hispanic	-.03	-.03	-.03	-.03
Black	-.04	-.04	-.04	-.04
Asian	-.04	-.04	-.04	-.04
Some other race	.05	.05	.05	.05
Female	.11	.11	.11	.11
Age at Wave I	-.00	-.00	-.00	-.00
Verbal ability	.00***	.00***	.00***	.00***
Missing	.00	.00	.00	.00
Parent's age at adolescent's birth	.00**	.00**	.00**	.00**
Missing	-.03	-.03	-.03	-.03
Parental education: *(Less than high school)*				

Table 6. OLS Regressions Predicting Cumulative GPA by End of High School.				
	Model 1	Model 2	Model 3	Model 4
High school graduate	.06*	.06*	.06*	.06*
Some college	.13***	.13***	.13***	.13***
College graduate	.15***	.15***	.15***	.15***
Family income	.00***	.00***	.00***	.00***
Missing	-.00	-.00	-.00	-.00
Ninth grade GPA	.78***	.78***	.78***	.78***
Missing	.55*	.55*	.55*	.55*
Urbanicity: *(Suburban)*				
Urban	-.02	-.02	-.02	-.02
Rural	.02	.02	.02	.02
Private school	-.01	-.01	-.01	-.01
R^2	.82	.82	.82	.82
BIC`	-11800	-11795	-11780	-11784

p<=.05 **p<=.01 ***p<=.001

Table 7. Logistic Regressions Predicting High School Completion.				
	Model 1	Model 2	Model 3	Model 4
Two parent family at birth	1.39*	1.31*	1.28	1.30*
Ever had family disruption		.84		
Number of family transitions: *(none)*				
One transition			.93	
Two transitions			.70*	
Three or more transitions			.84	
Timing of family transitions: *(none)*				
Early childhood transition				.78
Middle childhood transition				1.12
Adolescent transition				.76
Race/ ethnicity: *(White non-Hispanic)*				
Mexican American	1.15	1.15	1.15	1.15
Other Hispanic	.81	.81	.81	.81
Black	.89	.89	.89	.89
Asian	1.27	1.27	1.27	1.27
Some other race	.88	.88	.88	.88
Female	1.57***	1.57***	1.57***	1.57***
Age at Wave I	1.00	1.00	1.00	1.00
Verbal ability	1.02***	1.02***	1.02***	1.02***
Missing	1.01	1.01	1.01	1.01
Parent's age at adolescent's birth	1.02	1.02	1.02	1.02
Missing	.34	.34	.34	.34
Parental education: *(Less than high school)*				

Table 7. Logistic Regressions Predicting High School Completion.				
	Model 1	Model 2	Model 3	Model 4
High school graduate	1.38	1.38	1.38	1.38
Some college	2.03***	2.03***	2.03***	2.03***
College graduate	3.2***	3.2***	3.2***	3.2***
Family income	1.01**	1.01**	1.01**	1.01**
Missing	1.28	1.28	1.28	1.28
Urbanicity: *(Suburban)*				
Urban	.70	.70	.70	.70
Rural	.83	.83	.83	.83
Private school	1.84	1.84	1.84	1.84
Log likelihood	-2008.62	-2006.66	-2004.64	-2003.33
BIC`	-309	-304	-290	-293

p<=.05 **p<=.01 ***p<=.001

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