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Trajectories of Unintended Fertility*

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Abstract

Having an unintended birth is strongly associated with the likelihood of having later unintended births. We use detailed longitudinal data from the Add Health Study (N=8,300) to investigate whether a host of measured sociodemographic, personality, and psychosocial characteristics select women into this "trajectory" of unintended childbearing. While some measured characteristics and aspects of the unfolding life course are related to unintended childbearing, explicitly modeling these effects does not greatly attenuate the association of an unintended birth with a subsequent one. Next, we statistically control for unmeasured time invariant covariates that affect all birth intervals, and again find that the association of an unintended birth with subsequent ones remains strong. This persistent, strong association may be the direct result of experiencing an earlier unplanned birth. We propose several mechanisms that might explain this strong association.

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Keywords

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More than 40% of all pregnancies and close to 40% of all births in the United States are unintended – i.e. the mother reported that at the time of pregnancy she did not intend to get pregnant at that time or she intended to have no more children (Finer and Henshaw 2006; Finer and Zolna 2016). Moreover, Guzzo and Hayford (2011) show that over 40% of women who have one unintended birth go on to have one or more subsequent unintended births. As a result, unintended fertility is concentrated among a subset of women who are likely to have multiple unintended births (Wildsmith, Guzzo, and Hayford 2010). Given the negative outcomes associated with unintended fertility (U.S. Department of Health and Human Services 2009; Kissin, Anderson et al. 2008; Logan et al. 2007), the concentration of unintended births has important implications for inequality in health and human capital outcomes. Our research seeks to understand this concentration of unintendedness using longitudinal data from the National Longitudinal Study of Adolescent to Adult Health (Add Health).

This research also addresses a puzzle at the heart of many analyses of longitudinal processes: to what extent are the outcomes following an event reflective of selective characteristics and experiences early in the life course, and to what extent is a life course event fundamentally transformative? Or as Heckman (1991:75) has phrased it, a “basic problem in social science” is detecting, for a particular outcome, the importance of “initial endowments” (i.e., selectivity) versus “state dependence” (i.e., the effect of experiencing the event). This is a fundamental question in life course research (Elder 1998).

Below, focusing on the association between an early unintended birth and a subsequent unintended birth, we discuss the selection processes potentially at play followed by a discussion of the possible causal mechanisms (i.e., state dependence). Our empirical and methodological contributions are twofold: First, we leverage the longitudinal data and the rich psychosocial and personality information collected in Add Health to more fully examine the role of selection into initial unintended births. Second, we estimate the impact of time invariant unobserved characteristics. These analyses show that both measured and unmeasured factors substantially impact the risk of subsequent unintended fertility, but even combined these selective factors do not account for the powerful association between an unintended birth and a subsequent one. The robustness and magnitude of the association between an unintended birth and subsequent ones is evidence of state dependence. This evidence is a contribution to the literature on unintended fertility – we argue that a combination of selection and causal factors are likely at play in creating trajectories of unintended childbearing. But our work also contributes to the life course literature more generally – by providing a substantive example of state dependence and a strategy that can help identify such transformative events.

Selection into Unintended Fertility

An unintended birth is not, of course, a randomly occurring event; it is differentially distributed by measured (or observed) sociodemographic characteristics, such as age and race-ethnicity, and almost certainly by some characteristics unmeasured (or unobserved) in the data we use, variables such as underlying fecundity or a willingness to report a birth as unintended. To the extent that these observed and unobserved characteristics are persistent, the factors that lead to an initial unintended birth will also produce subsequent unintended births.

Past research has identified observable socioeconomic and demographic risk factors for unintended fertility. For instance, unintended births make up a higher proportion of births to teen and young mothers compared to older mothers (Barber and Emens 2006). Relationship status is also an important influence on the likelihood of an unintended birth (Williams, Abma, and Piccinio 1999; Guzman et al. 2010; Hayford and Guzzo 2010). Although nonmarital childbearing has become increasingly common, unmarried women remain more likely to have unintended (vs. intended) births compared to married women (Guzman et al 2010; Williams et al. 1999). Likewise, cohabitation has become more widespread, and the proportion of intended births to cohabiting women has increased, although the proportion is still lower compared to married women (Hayford and Guzzo 2010; Mosher, Jones, and Abma 2012). Race-ethnicity is also strongly associated with unintended fertility: black women consistently report more births as unintended compared to either whites or Hispanics (Chandra et al. 2005; Mosher et al. 2012; Wildsmith et al. 2010), and Hispanic women report more unintended births than do whites (Wildsmith et al. 2010). Socioeconomic characteristics such as education and access to financial resources are strongly associated with unintended fertility (Finer and Henshaw 2006; Musick et al. 2009; Williams et al. 1999). Greater education and income are thought to reduce the rate of unintended fertility by increasing women's autonomy, enhancing their self-esteem and self-confidence, and increasing the opportunity costs of unintended childbearing (Blumberg and Coleman 1989; Musick et al. 2009). Higher socioeconomic status also increases access to and the affordability of family planning services (Frost, Singh, and Finer 2007). In our analyses, we account for these social and demographic characteristics that are known to be associated with unintended fertility.

Psychological and Psychosocial Factors

While background sociodemographic characteristics are fundamental to reproductive intentions and behavior, Guzzo and Hayford (2011) show that the association between early and later unintended fertility persists even after controlling for many of them. They suggest that psychological and psychosocial characteristics may partly explain the connection between early and later fertility, though they were unable to explicitly examine these factors. We build on their research by drawing from psychological research that shows that personality differences are an important, yet understudied influence on sexual and childbearing intentions and behaviors (Miller 1992; Alvin 2005; Jokela and Keltikangas-Jarvinen 2009; Jokela et al. 2011).

In the most simplified explanation, individuals possess certain psychological traits that change little over their lifetime and provide the motivation for childbearing (Miller 1992). This early research also demonstrated that individuals with personality characteristics such as nurturance and affiliation had stronger motivation for childbearing, whereas those with a high degree of autonomy had weaker motivation for childbearing. In turn, motivations for childbearing are related to the desire to have a child(ren), number of children, and timing of children. More recently, studies show that underlying differences in personality traits such as conscientiousness, extraversion and neuroticism drive planfulness not only in sexual behavior (Hoyle et al. 2000; Miller et al. 2004; Schmitt and Shackelford 2008), but also in other domains such as personal relationships (Ahmetoglu, Swami, and Chamorro-Premuzic 2010), and educational and career aspirations (Miller and Rodgers 2001). In this paper, we focus on conscientiousness and aspirational goals as potential selective mechanisms.

Conscientiousness, openness, extraversion, agreeableness, and neuroticism are collectively identified as the “big five” personality dimensions (Caspi and Shiner 2001), and form the core of individual personality predispositions and behaviors. They develop during adolescence, and while behaviors may change over the life course, the underlying personality traits are fairly stable throughout adulthood (Caspi and Shiner 2006). We chose to analyze conscientiousness because it is the personality dimension that has been most consistently linked to risky sexual behavior and unintended fertility (Hoyle et al. 2000; Miller et al. 2004; Smith and Shackelford 2008). In essence, conscientiousness represents dependability and is manifested in traits such as “being careful, thorough, responsible, organized and planful” (Barrick and Mount 1991:4). Previous research has shown an association between conscientiousness and risky behaviors, including sexual risk-taking such as casual sex, sex with multiple partners, and nonuse of contraception (Hoyle et al. 2000; Miller et al. 2004; Raffaelli and Crockett 2003; Wulfert et al. 2002). As such, it is likely to be strongly related to unintended childbearing (Hoyle et al. 2000). In other words, women who are less conscientious are less likely to have long-term plans for their future and therefore are less likely to be efficacious in their use of contraception. In fact, Berg et al. (2013) examined the planning status of pregnancies among a cohort of British men and women and found that women with low conscientiousness were more likely to have an unplanned pregnancy (compared to those with a high degree of conscientiousness). In our study, exploratory analyses confirmed this association and found that other personality factors were not associated with unintended births.[1]

For young adults, college aspirations may also lower the risk of an unintended birth. The desire to continue schooling would raise the opportunity costs of early childbearing, and is associated with healthier behaviors and lower risk-taking in adolescence (McDade et al. 2011). To the extent that expectations about completing college reflect a general future orientation or professional ambition, they may continue to be associated with lower rates of unintended fertility even into adulthood.

[1]We also considered a related concept, risk-proneness (the propensity to be attracted to risky activities), but it was highly correlated with conscientiousness. Similarly, we explored other factors hypothesized to be associated with unintended fertility, such as mastery (Kirby 2002) and closeness to parents (Santelli and Beilenson 1992). These analyses indicated weak associations with unintendeness net of variables already in the model. Additional measures of personality traits did not explain the association between early and later unintended fertility.

Religiosity is a third factor that may influence the likelihood of an unintended birth. In the contemporary United States, religiosity is closely associated with political and cultural schemas that stress traditional family values, including the importance of parenthood and opposition to abortion. Moreover, religiosity is associated with higher intended family size (Hayford and Morgan 2008). In addition, previous research using Add Health has found that religiosity, and in particular religion-based virginity pledges, is associated with delayed coital debut but lower likelihood of contraceptive use at first sex (Bearman and Bruckner 2001; Rostosky, Regnerus, and Wright 2003). These conflicting mechanisms lead to some uncertainty about the overall effect of religiosity on the risk of an unintended birth.

The rich longitudinal information available in Add Health permits us to estimate the impact of these and other measured factors, but a range of other individual-level factors could also be important and are unobserved. For instance, some women are more fecund[2] than others. This greater fecundity would make them more likely to become pregnant given sexual intercourse and less-than-perfect contraceptive use. As another example, some women may be unwilling to admit to an unintended pregnancy because of stigma associated with sexual risk-taking or contraceptive failure, while other women may be more likely to label a birth as unintended to avoid admitting to purposely having an early or nonmarital birth. Willingness to report a birth as unintended would impact a woman's retrospective reports of intendedness for all her births. Our analytic strategy controls on all time invariant unobservable characteristics.

The Consequences of an Unintended Birth

The economic literature (Heckman and Borjas 1980; Heckman 1980; Becker and Murphy 1988) offers a clear conceptualization of how an event can impact subsequent ones. In their account of *state dependence*, Heckman and Borjas (1980) observed that individuals who have already experienced an event, such as unemployment, have a greater likelihood of experiencing the same event in the future. True state dependence would arise if the individuals' preferences, choice sets, and constraints are affected as a result of their exposure to an earlier event, thereby affecting their subsequent behavior.

The women most likely to have a first unintended birth are disproportionately unmarried low-income women. Qualitative accounts depict children as a primary source of meaning and purpose for these women - even unplanned pregnancies are opportunities to "do the right thing" and to "be there" for their children. (Edin and Kefalas 2005). These women's narratives include limits and constraints to what women can realistically hope to attain (i.e., a stable relationship, economic security). Having an early unintended birth reinforces both these practical limits, and their fatalism and perceived lack of control. These outlooks in turn may shape their subsequent contraceptive behavior and other behaviors that might increase the risk of additional unintended pregnancies.

[2]Fecundity is the biological capacity to reproduce and is usually defined as the monthly probability of conception (given no contraception). Although fecundity changes across the life course, for any individual women fecundity at different ages is strongly correlated with early fecundity.

An early unintended birth might also influence later fertility through its impact on romantic and sexual relationships. An unintended birth can strain an existing relationship, resulting in a higher risk of union dissolution in both cohabiting (Wu and Musick 2008) and marital unions (Guzzo and Hayford 2012). To the extent that unintended births are more likely to occur in cohabiting relationships, women in such unions face challenges in entering marital unions subsequently and are therefore open to potentially further unintended births. Women who are not in unions, or whose unions have been dissolved, face a lower risk of birth, but higher risk of a subsequent unintended pregnancy/birth. In our analysis, we partially control for this pathway to unintended births using information on coresidential relationships in the survey.

Another possible causal pathway focuses on abortion. When asked on surveys, many women are willing to state their pro-choice or pro-life attitudes, but these attitudes are disembodied from their own circumstances and opportunities should they experience an unintended pregnancy. We conceptualize an unintended pregnancy as a classic “conjuncture”, a situation or event that requires an individual to draw on virtual and material social structures in order to understand her situation and to move forward (Johnson-Hanks et al. 2011:15; Sewell 1992; 2005). A woman who becomes unexpectedly pregnant makes a decision about whether to carry the pregnancy to term, and a woman who has an unintended birth makes a series of decisions about her relationship with the child’s father, her relationship with her own family, and her education and employment behavior. In making these decisions, she might draw on schemas about the acceptability of abortion (Luker 1984); the importance of planning for children (Sawhill, Thomas, and Monea 2010); or the understanding of an unintended pregnancy as a chance to “grow up”, “do the right thing” and bring order to one’s life (Edin and Kefalas 2005). At the same time, material resources such as access to abortion, availability of family support for raising a child, and financial resources shape the possibilities both for interpreting the conjuncture of unintended pregnancy and for defining possible decisions.

This unintended pregnancy conjuncture forces a choice, and the choice is likely rationalized in key narratives the woman constructs about herself and her life. Women who decide to carry an unintended pregnancy to term may be likely to do it again, while those who decide to terminate a pregnancy may find it acceptable to do the same for a future unplanned pregnancy. As such, the first unintended pregnancy may produce a decision that constrains subsequent ones, a classic transformative event.

We do not attempt to distinguish between these pathways analytically; it is likely that some combination of mechanisms connects early unintended fertility to later births. But any causal argument is anchored in the logic of the life course – transitions that are irreversible (i.e., becoming a parent) set the stage for future transitions and may fundamentally alter subsequent trajectories. It is not simply whether an event happened or not, but the conditions in which that event happened and how the event is construed and experienced that is especially consequential. As such, an off-time or unexpected transition, such as an unintended birth, may be an important transformative event that shapes the subsequent life course trajectory.

Hypotheses

Following from the discussion above, we propose both selection and transformative mechanisms that produce the association between an unintended birth and subsequent ones.

1. Selection of women into a trajectory of unintendedness
    a. Measured sociodemographic characteristics (age, race, education, family structure, relationship status) are associated with a trajectory of unintended childbearing.
    b. Women who are more conscientious, have strong educational aspirations are less likely to have repeat unintended births.
    c. Highly religious women have a lower likelihood of having repeat unintended births.
    d. Unobserved characteristics (such as fecundity and a willingness to report an unintended birth) are associated with repeat unintended births.
2. Transformative effect (i.e., state dependence) of unintended births
    a. An early unintended birth is strongly associated with subsequent ones, net of sociodemographic characteristics, personality traits, religiosity, and unobserved characteristics.

Data and Methods

We use longitudinal data from the National Longitudinal Study of Adolescent to Adult Health (Add Health), a nationally representative sample of school-based adolescents in grades 7–12 in 1994–95 (Harris 2010, 2013). These adolescents were interviewed in four waves beginning in 1994–1995 in Wave 1 and followed through 2008–09 in Wave 4, when respondents were 24 to 32 years old. We use data from the first and last waves that provide rich information pertaining to sociodemographic characteristics, family background, religiosity, mental and physical health, and personality traits in addition to detailed information on relationship histories (romantic/cohabiting/marriage relationships) and birth histories. Additionally, we use information on the date of high school graduation from the third wave to construct our measure of education.

We restrict our analyses to female respondents because of concerns about the quality of fertility data for men (Joyner et al. 2012). In Wave 1, 10,480 women were interviewed, of which 8,343 women were followed up and re-interviewed in Wave 4. We analyze live births as the outcome in our study, restricting our sample to those who had valid information on the intendedness of the birth (excluding 43 women). The final analytic sample has 8,300 women, and 8,334 births to 4,326 mothers (see Table 1).

Measures

We measure birth intendedness at parities one, two and three using the standard question: “Thinking back to the time just before this pregnancy with (partner), did you want to have a child then?” Negative responses to this question are categorized as unintended births and

positive answers are identified as intended births. Accordingly, we construct three possible outcomes in each risk segment whether the woman had no birth, an intended birth or an unintended birth.

In order to examine Hypothesis 1a, we analyze key demographic and socioeconomic characteristics that are thought to be associated with a higher risk of unintended fertility. For the first birth analysis, we include age and age-squared as time-varying variables. For subsequent parities, we include age and age-squared as time-varying variables and indicators for whether age at first birth was under 20 years or over 25 years (with age between 20 and 24 years being the reference). Additionally, we include a control for duration since last birth as a time-varying categorical variable with three categories: duration less than 24 months, and over 48 months, with duration between 24 and 48 months being the reference category. We also include controls for race-ethnicity (non-Hispanic white, black, Hispanic, and other race) and education, measured as a time-varying indicator using data on the date of high school graduation (date of college completion is unfortunately not available in Add Health.) We control for family dynamics during adolescence by including an indicator for family structure at Wave 1 (intact biological family, step family, other family type) and maternal education (less than high school degree, high school degree, some college, and college graduate). Our analyses include a time-varying measure for relationship status for each month in the analysis: whether the respondent was married, cohabiting, or not in any co-residential union.

To examine Hypothesis 1b, we analyze conscientiousness and educational aspirations from Add Health. Conscientiousness is constructed by the Add Health team using the 20-item Mini-IPIP, a short form of the standard 50-item International Personality Item Pool – Five Factor Model measure (Donnellan et al. 2006). See Appendix I for details on the items included in the measure. The personality dimensions were measured in Wave 4; thus the timing of this measurement post-dates the behavior we want to explain.[3] But previous research has shown that these characteristics are generally stable from adolescence through adulthood (Roberts, Caspi, and Moffitt 2001). Respondents' plans for future education are reported in Wave 1, and measured in response to the question: On a scale of 1 to 5, where 1 is low and 5 is high, how likely is it that you will go to college? Responses are coded as a single linear variable with higher values indicating greater likelihood of attending college. To examine Hypothesis 1c, we analyze religiosity measured in Wave 1. The importance of religion is measured using a four-point Likert scale in response to the question: How important is religion to you? Very important; fairly important; fairly unimportant; and not important at all. We coded religiosity as a dummy variable with 1 indicating that religion is very important and 0 indicating all other responses. So we do not lose respondents, we created an indicator variable if religiosity was not reported.

To address Hypothesis 2a, we use the intention status of the first (and second) birth to predict whether subsequent risk segments included no birth, and intended birth and an

[3]In analyses not shown, we include two variables from Wave 1 that come close to what we seek to capture through conscientiousness. The results from these models are slightly conservative compared to what we obtain using the Wave 4 measure of conscientiousness. Results available upon request.

unintended birth. To elaborate, the model examining the intendedness of the first birth measures how selection characteristics (described earlier) influence whether the first birth was unintended versus intended. Subsequently, we predict whether the second birth was intended or not using the intention status of the first birth (intended or not) as the explanatory variable (net of selection characteristics). In predicting whether the third birth was intended or not, we use the intention status of the first two births (first and second births unintended; first and second births intended; first birth unintended, second birth intended; and first birth intended, second birth unintended), net of selection characteristics.

Methods

We use a multiple spell, discrete-time competing risk hazard model to estimate the determinants of the timing of births categorized as no birth, intended birth, or unintended births on a parity-specific basis. We follow women from the beginning of their childbearing years, which we set at age 15, until they are interviewed in Wave 4 (at age 24 to 32) or had a third birth. One month risk periods are the unit of analysis. By initiating the process at age 15 for childless adolescents, we do not have to concern ourselves with left censoring (selectivity) for the first birth interval.

We use a competing risk framework to model outcomes (intended birth, unintended birth, and no birth) in each risk segment; we estimate the models for 1st, 2nd and 3rd births simultaneously to control for selection into higher parity risk segments. Because our primary substantive interest lies in the intendedness of births, we focus on the likelihood of having an unintended birth relative to an intended birth at each parity in the results section. Essentially, these results describe, among women having a birth, the conditional likelihood of having an unintended birth. They thus speak to the conditions in which children are born rather than describing women's experiences of becoming a mother or not. Results for the other contrasts (unintended birth vs. no birth, intended birth vs. no birth for each parity) are available on request.

The statistical specification for the first birth interval is as follows:

$$\ln\left[\frac{P(B_{1it}=2)}{P(B_{1it}=1)}\right]=X_{it}\beta_{12}+\mu_{12i} \quad (1)$$

$$\ln\left[\frac{P(B_{1it}=3)}{P(B_{1it}=1)}\right]=X_{1it}\beta_{13}+\mu_{13i} \quad (2)$$

Where the first subscript on all variables denotes the first birth interval for woman i (i=1,2, …,N) at month t (t=1,2,…T_{1i}). The dependent variable is a categorical variable taking on three values: 1 for no birth for woman i in month t, 2 for an intended birth, and 3 for an unintended birth. The X_{1it} terms represent exogenous variables that affect the birth probabilities. While most of these variables are fixed through time (mother's education and respondent's race, for example), some (such as the respondent's age, education, and

relationship status) are time-varying. We use the t subscript for the entire set of variables to simplify notation. Note that all respondents start the process at the same age and move forward one month at a time and so age effectively controls for duration dependence. The β's are unknown parameters to be estimated reflecting the effect of exogenous variables on fertility. This model is differentiated from a standard event history model by the explicit inclusion and estimation of the μ terms, which represent unobserved time invariant characteristics of individuals, commonly referred to as time invariant unobserved heterogeneity. The statistical specification for birth intervals two and three has the following form, where k represents birth order (k=2,3 for second and third births):

$$\ln\left[\frac{P(B_{kit}=2)}{P(B_{kit}=1)}\right]=X_{kit}\beta_{k2}+Y_{kit}\alpha_{k2}+\mu_{k2i} \quad (3)$$

$$\ln\left[\frac{P(B_{kit}=3)}{P(B_{kit}=1)}\right]=X_{kit}\beta_{k3}+Y_{kit}\alpha_{k3}+\mu_{k3i} \quad (4)$$

To obtain appropriate estimates of the hazard of having intended and unintended births and variation in these hazards, women who do not have births at each parity remain in our estimation procedure; T_{ki}, the number of observations for woman i at birth order k (k=2,3), is equal to zero if woman i does not transition to higher birth intervals. The definitions of the variables are similar to equations (1) and (2), with the addition of a new set of covariates, Y_{kit}, representing the intendedness of previous births with dummy variables as described in the measures section. The coefficients α are thus the main indicator of an effect of unintended fertility on subsequent childbearing (state dependence).

We allow the μ's to be correlated across birth intervals. To estimate this correlation, we estimate the three models simultaneously. This approach reduces the omitted variable bias that would be induced if the unmeasured characteristics were correlated with measured predictor variables as well as unintended fertility. In particular, it accounts for selection into unintended fertility based on unmeasured characteristics. If the same unmeasured characteristics predict both early unintended births and later unintended births, estimating models with uncorrelated error terms would leave out these effects, and the coefficients for early unintended births would represent both true effects and the impact of these omitted variables (see, for example, Heckman and Singer 1984; Wooldridge 2002). Our approach properly controls for unmeasured heterogeneity and thus provides unbiased estimates of the coefficients for state dependence.

To estimate the models, we use a variation of the discrete factor approximation (Heckman and Singer 1984) rather than assuming a specific parametric distribution for the μ's (for example, multivariate normality is often assumed). Specifically, we use what Mroz (1999) refers to as nonlinear heterogeneity where mass points are estimated for each interval along with a common set of probabilities. This form for the discrete factor model allows for very general patterns of correlation across birth intervals and has been shown to perform

substantially better than parametric methods when the true error distribution is not normal (Guilkey and Lance 2014; Mroz 1999). Recent substantive applications of this approach include Rindfuss et al. (2007), Rindfuss et.al. (2010), and Kane et al. (2013).

Our key results emerge from comparisons across four models. The first model, our baseline model, includes only a basic set of control variables (e.g., age, race/ethnicity, own and mother's education, family structure in adolescence, relationship status). This model parallels the one estimated by Guzzo and Hayford (2011) using a cross-sectional survey (the National Survey of Family Growth, NSFG). Our replication of Guzzo and Hayford (2011) is not exact; our sample differs in several ways from the NSFG. Most importantly, Add Health is a longitudinal survey and the oldest respondents are 32 years old at Wave 4. In contrast, the cross-sectional NSFG included those up to age 44. Add Health's truncated period of observation means that many births to women in their thirties are not included in our analysis. Because these births are more likely to be intended than births to younger women, their exclusion reduces the sample-wide association of unintended births across parity. Thus, the association produced in our analysis is weaker than Guzzo and Hayford's (2011) estimate.

Model 2 includes a more extensive set of measured covariates available in the longitudinal data (conscientiousness, religiosity, and aspirations for education). Both Models 1 and 2 are "naive" models in the sense that they assume no unmeasured heterogeneity. Models 3 and 4 re-estimate these first two models including a correction for unmeasured time invariant covariates. These models provide our preferred estimates.

Comparison of logit coefficients across models can be problematic (Allison 1999). This results because, just as in probit models, coefficients from different estimations will be scaled by different unknown factors that are a function of the underlying error distributions in the separate equations. We have adjusted coefficients as suggested by Karlson et al. (2012) and Breen et al. (2013) and find that these adjustments do not influence the pattern or magnitude of estimates discussed here. Thus, our tables show only the unadjusted coefficients.

Results

Table 1 shows the distribution of key sociodemographic characteristics and fertility intentions for the Add Health mothers. More than half (55.5%) of the mothers in this sample had at least one unintended birth. About 46% of mothers reported an unintended first birth, declining substantially for second births (20.6% unintended) and third births (8.5%). Because our primary research question is whether the intendedness of early births predicts the intendedness of later births, we created a categorical variable linking intentions of first and second births among those with at least two births. Here, we see that more than a third of the mothers with two or more births intended both their first two births (37.0%). Slightly more than 10% reported an intended first birth, followed by an unintended second birth (11.3%). More than a quarter (28.0%) reported an unintended first birth and an intended second birth. About a quarter (23.7%) reported that both their births were unintended.

Just over one-fourth of the mothers had their first child before they were 20 years (26.6%), and another fourth had their first child when they were 25–29 years old (26.0%). More than 40% (43.9%) had their first child between the ages of 20–24 years. Very few of the mothers in this sample (3.5%) began childbearing at or after 30 years.

Table 2 displays the distribution of births, by birth order and fertility intentions. Slightly less than half of first births (46.9%), 34.7% of second births and 41.0% of third births were unintended. Overall, about 42% of all births were unintended. Table 3 shows the mean values of the psychosocial measures used in this analysis.

Tables 4, 5, and 6 show the effects of covariates on the likelihood of having an unintended vs. an intended first, second and third birth, respectively. We begin with Table 4, which presents the relative risk ratios (RRRs) from competing risk models predicting an unintended first birth (relative to an intended first birth) to capture the process of selection into a first unintended birth; as noted above, we do not show the other contrasts. We discuss these results only briefly, as our main interest is in the consequences of the first unintended birth. Model 1 includes the basic set of controls and does not account for unmeasured heterogeneity. As anticipated based on prior research, first births are more likely to be unintended among younger mothers, nonwhites, and those not living with two biological parents at Wave 1. Also, women who are in any co-residential union at the time of birth (married or cohabiting) have significantly lower risks of having an unintended vs. an intended first birth; however, the effect of being married is much stronger than merely cohabiting (marriage reduces the risk of an unintended first birth by 79% compared to 34% for cohabitors). These effects persist across all models, even after accounting for personality characteristics (Models 2) and correcting for unmeasured heterogeneity (Model 4).[4]

As expected, additional covariates added in Model 2 have clear effects. Conscientiousness reduces the risk of an unintended (vs. an intended) birth; however the effect is not significant in Model 4 after accounting for unmeasured heterogeneity. Being very religious reduces the risk of an unintended (vs. an intended) birth, and these effects persist after accounting for unmeasured heterogeneity. Women who aspired to attend college at Wave 1 also have a lower risk of having an unintended birth in Model 4.

Table 5 shows models predicting the birth planning status of the second birth to answer our core question: whether having an early unintended birth is associated with later unintended births. With just the basic set of controls (Model 1), the risk of a second unintended birth (compared to an intended one) among those whose first birth was unintended increases by more than double (a factor of 2.04). Without these basic controls, the estimated effect is 2.59 (result not shown here); thus, the basic set of controls explains some, but not most, of the strong association between early and later unintended fertility. These estimates provide a replication of the basic findings of Guzzo and Hayford (2011).

The most important result in Table 5 is the robustness of the effect of an unintended birth despite adjustments for observed and unobserved covariates. As we look across the first row

[4]While not shown here these basic findings also hold for the comparison of an unintended birth vs. no birth. Results available upon request.

of Table 5, we see no consistent attenuation of this effect as we add the rich set of controls available in Add Health (Model 2), a control for unmeasured time invariant covariates (Model 3) or both (Model 4). Rather, including unmeasured heterogeneity with and without the additional controls (Models 3 and 4) modestly strengthens the effect of an unintended first birth on the likelihood of a second unintended birth.

Note that college aspirations and conscientiousness have strong effects in the predicted directions, i.e., both reduce the risk of an unintended second birth. Specifically, those who report aspiring to attend college in the Wave 1 interview have a lower risk (lower by a factor of .88 or reduced by 12% in Model 2) of an unintended second birth. In the case of the conscientiousness scale, an increase by one step on the scale reduces the risk of the second birth being unintended by a factor of 0.95 (or by 5%, see Model 4). Comparing respondents who are roughly one standard deviation above or below the mean (i.e., that are separated by roughly six steps on this scale (0.95^6) produces a relative risk ratio of about 0.73 (or a 27% reduction in risk). Thus, conscientiousness clearly has an important effect on the risk of repeat unintended births, but it does not explain the association between early and later unintended fertility. [1]

In Table 6, we show results for the third birth interval. The key covariates in these models are indicators of whether the first and second births were unintended. Net of the basic set of controls in Model 1, women whose first two births were unintended (compared to both intended) were 3.91 times more likely to report their third birth as unintended. We also include contrasts for the situation when only one of the first two births was unintended. The risk of the third birth being unintended is stronger if either of the first two births was unintended (compared to the omitted category: both were intended. As with the results in Table 5, these effects are robust to the addition of other control variables. The estimated effects of prior birth unintendedness are not attenuated by the inclusion of additional measured variables (Model 2) or by adjusting for unmeasured time invariant covariates (Model 3 and 4). In fact, the effect of a first and second unintended birth appears strongest in Model 4 (after correction for unmeasured heterogeneity).

This estimated coefficient (25.63) is substantially larger than any other coefficient in any other model, suggesting some instability in the estimates, possibly related to the smaller sample sizes for third births. Still, all models show a consistently strong effect of earlier unintended fertility on later birth intendedness. Statistical tests of the effects of unobserved characteristics provide strong evidence of person-specific tine invariant unobserved heterogeneity. Likelihood ratio tests of the null hypothesis that the heterogeneity parameters are jointly zero yield p-values that are essentially zero for both Models 3 and 4, and the error terms are strongly correlated across parity-specific models. Thus, Models 3 and 4, which account for this unobserved heterogeneity, provide better estimates of “state dependence”

[1]As noted earlier, we carried out parallel analyses with the other four dimensions of personality and a measure of risk-proneness. (Results from these analyses are available on request.) We included these variables one at a time as a substitute for conscientiousness. Although openness and agreeableness had weak effects on intendedness of a second birth in bivariate models, they were not significant in models with basic controls. Further, none of the other personality dimensions attenuates the effects of an earlier unintended birth at all.

(the effect of an unintended birth) than the naïve models. See Appendix 2 for the estimates of unobserved heterogeneity and the correlations across equations.

Supplemental Analysis

The surprisingly strong and persistent effect of an unintended birth on the likelihood of subsequent ones begs for replication. Rather than leave this as future work, we have reproduced key results using data from NLSY79 (National Longitudinal Survey of Youth) followed through the 1990 survey wave. This produces a sample roughly comparable to Add Health in its age structure. Appendix 3 presents and briefly describes our procedures and results. This analysis is not identical to the one we describe above because: i) not all Add Health variables are available in the NLSY79, ii), the NLSY79 sampling design is very different from Add Health and iii) the NLSY79 contains earlier birth cohorts than Add Health. But the analyses are substantively very similar and a priori we had no strong reason to believe that results should vary dramatically across these two widely used and highly respected national surveys. In fact, the NLSY79 results mirror all the key features described above from the Add Health Data. Specifically, we replicated Models 1 and 3 in Tables 4, 5 and 6, and find that: i) unintended fertility strongly predicts subsequent unintended fertility, ii) observed covariates have significant and substantively plausible effects, iii) there is strong evidence that unobserved factors impact the likelihood of subsequent unintended births, and iv) net of observed and unobserved covariates, a previous unintended birth remains a powerful predictor of subsequent ones. These results show that our results are not confined to one data source or to a single set of cohorts.

Discussion

Unintended fertility in the United States remains high, with evidence that it has become increasingly concentrated among subsets of women (Wildsmith et al. 2010). Further unintended fertility is an issue of substantial public policy and public health importance (Barber, Axinn, and Thornton 1999; Pulley et al. 2002; Santelli et al. 2003; D'Angelo, et al. 2004). Unintended fertility is linked to poorer maternal and child health outcomes, and repeat unintended fertility may exacerbate the negative consequences of a single unintended birth. Guzzo and Hayford (2011) show that an early unintended birth significantly increased the likelihood of a subsequent unintended birth. In our study, we extend Guzzo and Hayford's work with richer data and a more rigorous analysis. The accumulated evidence shows that the association of the intendedness of a low parity birth with the likelihood of additional unintended births is of a large magnitude, is robust to measured and unmeasured controls, and has been estimated from multiple high-quality surveys with large sample sizes. The question is: why does this association exist?

Unlike Guzzo and Hayford, we explicitly set out to answer this question, distinguishing between selection processes and the possible direct effects of an unintended birth. This is particularly important given concerns that any outcomes associated with unintended fertility are just that – merely associations. Gipson, Koenig, and Hindig (2008) argue that since most research is cross-sectional, much of the negative linkages are likely to be driven by selection, endogeneity, and unobserved heterogeneity. Our analyses account for selection processes by

controlling for a wide range of measured characteristics and by incorporating time invariant unmeasured characteristics. These selective processes are not “nuisance parameters” to be estimated and ignored. Having the first birth at a young age or being black, for instance, sharply increase the likelihood of a first unintended birth and of having subsequent ones. These variables may signal low economic resources that reduce access to contraception, lower incentives for contraception at both low and high parities, or social and environmental influences affecting the acceptability of unintended fertility.

Other measured characteristics also influence unintended fertility. For example, conscientiousness is associated with lower risks of unintended fertility at all parities.[2] This construct, operationalized by items such as orderliness and organization, could clearly impact the likelihood of consistent contraceptive use or planful approaches to parenthood. As expected, college aspirations reduce the likelihood that the first birth is unintended. We also find that women for whom religion is very important have a lower likelihood of an unintended first birth. However, although these factors have substantial impact on the likelihood of an unintended birth, they do not explain the association between early and later unintended fertility.

Of course, even the richest survey data cannot include measures of all important sources of heterogeneity. To correct for omitted variable bias we estimated models that controlled for unmeasured time invariant covariates – our preferred models (Models 3 and 4 in Tables 4–6). As with the measured characteristics, these controls substantially improve model fit, but they do not alter the powerful association between early and later unintended fertility. Therefore our evidence is consistent with arguments that an unintended birth is a transformative event (i.e., “state dependence” is at work). This finding is consistent with a life course perspective emphasizing the timing and circumstances of key transitions and subsequent trajectories. Thus, our findings contribute to the small but growing body of research using rigorous methodological approaches that suggest a causal impact of unintended fertility on later outcomes (Herd et al. forthcoming; Kost & Lindberg, 2015; Lindberg et al. 2015).

Why might an unintended birth exert a powerful influence on the subsequent trajectory of unintendedness? Some of the impacts of unintended births may come through their effects on later work, education, and romantic and sexual relationships, effects that we only partially capture through our sociodemographic controls. But unintended births may also alter the way women think about subsequent childbearing. We argue that an unintended birth is a classic conjuncture (see Johnson-Hanks et.al. 2011) whose outcome impacts the subsequent life course. Prior to facing this conjuncture, it could be uncertain how it would be construed and resolved. But once a woman has had an unintended birth, the social, cultural, and economic resources she brings to bear on subsequent decisions about relationship

[2]Some readers will be troubled by the inclusion of the personality variable conscientiousness that is measured at Wave 4, after the outcomes of interest. Our approach assumes that personality traits are stable across adolescence and early adulthood (and thus the temporal ordering of conscientiousness and fertility is irrelevant). In contrast, religiosity and college aspirations are measured in adolescence and do not have this temporal ordering issue. Concerned readers may consider Model 3 (as opposed to 4) as the preferred model since it does not include the explicit measures of these variables. Other substantive conclusions are not affected by the inclusion/exclusion of these personality variables (as contrasts of models 1 and 2 and 3 and 4 show).

formation, sexual and contraception behavior, and abortion are shifted. For example, a woman might anticipate that her family would be disappointed or upset with an unintended pregnancy, but actually experience love and support after the birth; she might worry that she is not ready to be a parent, but find herself enjoying motherhood, or at least "making the best of a bad situation." Further, even if an unplanned pregnancy is initially met with disappointment and stigma from her social network, the ability to activate social resources and rely upon friends and family may ameliorate many of the perceived emotional and economic costs (Edin and Kefalas 2005). In these cases, women might feel less need to avoid future unintended births than a woman whose first birth was planned (and who thus has no firsthand knowledge about the possible consequences of an unintended birth).

Another potential mechanism lies in how women evaluate their risk of becoming pregnant again. Young men and women have a great deal of misperceptions about the reproductive process and contraception (The Henry J. Kaiser Family Foundation 2003; Wynn, Foster, & Trussell 2009). Women whose past unintended pregnancy occurred when they were contracepting or otherwise believed they were unlikely or unable to conceive may develop a fatalistic attitude toward pregnancy, in which they believe it is futile to try to control pregnancy and childbearing (Guzzo and Hayford 2012). In this scenario, it is not lower motivation to avoid a subsequent unintended birth that drives unintended fertility so much as lower motivation to use contraception.

Finally, early fertility experiences may solidify a woman's position regarding the appropriate means of resolving an unintended pregnancy. As with prior research on unintended fertility, we analyze births rather than pregnancies due to under-reporting of abortions in survey data (Jones and Kost 2006). As such, all the women in our analyses have chosen to carry an unintended pregnancy to term. In the initial unintended pregnancy conjuncture, a woman might be open to various options. However, her decisions regarding the first birth are a critical part of her life history: carrying an initial unintended pregnancy to term may solidify schemas about the negative moral or emotional consequences of abortion and reduce the chances that a later pregnancy will be terminated. Here, the mechanism is not an elevated risk of another unintended pregnancy but, rather, a high risk of carrying any unintended pregnancy to term.

Summary and Conclusion

Using Add Health data, we observe women from age 15 up to their late 20s or early 30s, a period when unintended births are common. Our estimates indicate that having a first unintended birth dramatically increases (by a factor of 2.5–3.0) the likelihood that the second birth is unintended rather than intended. A number of processes are likely at work to produce this association. Initial heterogeneity and selection play a modest role. But net of this observed and unobserved heterogeneity, we estimate that an unintended first birth increases the risk that the second is unintended by a factor of approximately 3.0 (see Table 5, Models 3 or 4). This this increased risk is consistent with "state dependence" (Heckman (1991:75) – i.e., experiencing this event (an unintended birth) changes the person and their life course trajectory so that subsequent behavior is altered.

We have proposed several pathways through which early unintended fertility may increase the likelihood that subsequent births are unintended; testing these potential explanations constitutes an important future research agenda. A second important focus for subsequent research is to document the salience of this trajectory of unintendedness across time and/or social groups. We have only shown that its average effect is powerful.

But more broadly, the approach used here provides a template for linking life course events, social structure, and cumulative disadvantage. Let us return to the conceptualization of an unintended pregnancy as a classic conjuncture (Johnson-Hanks et al. 2011). This conjuncture is not randomly distributed; it occurs in consistent locations in social space and is differentially construed across these social niches. The result is a strong social patterning of unintended childbearing that maps onto niches of social and economic disadvantage. But we argue that unintended fertility is more than a conduit for the transmission of disadvantage; instead our evidence is consistent with it being a transformative event vis-à-vis subsequent childbearing. It increases the likelihood of a subsequent unintended pregnancy and/or the likelihood that such a pregnancy will be carried to term. Thus, while this trajectory of unintendedness has its roots in structured disadvantage, an unintended pregnancy/birth may amplify dramatically this trajectory. Thus, this trajectory of unintendedness may contribute to the cumulative disadvantage among adults (DiPrete and Eirich 2006) and to children's diverging destinies (McLanahan 2004; Barber, et al. 1999).

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

Ahmetoglu G, Swami V, Chamorro-Premuzic T. The relationship between dimensions of love, personality and relationship length. Archives of sexual behavior. 2010; 39(5):1181–1190. [PubMed: 19705275]

Allison PD. Comparing logit and probit coefficients across groups. Sociological Methods & Research. 1999; 28(2):186–208.

Barber JS, Axinn WG, Thornton A. Unwanted Childbearing, Health, and Mother-Child Relationships. Journal of Health and Social Behavior. 1999; 40(3):231–257. [PubMed: 10513146]

Barber JS, East PL. Children's Experiences after the Unintended Birth of a Sibling. Demography. 2011; 48:101–125. [PubMed: 21336690]

Barber, JS., Emens, A. The Intersection among Unintended, Premarital and Teenage Childbearing in the U.S. Population Studies Center Research Report. University of Michigan; Ann Arbor, MI: 2006. 06-608

Barrick MR, Mount MK. The Big Five Personality Dimensions and Job Performance: A Meta-Analysis. Personnel Psychology. 1991; 44(1):1–26.

Bearman PS, Brückner H. Promising the Future: Virginity Pledges and First Intercourse. American Journal of Sociology. 2001; 106(4):859–912.

Becker GS, Murphy KM. A theory of rational addiction. The Journal of Political Economy. 1988:675–700.

Berg V, Rotkirch A, Vaisanen H, Jokela M. Personality is differentially associated with planned and non-planned pregnancies. Journal of Research in Personality. 2013; 47:296–305.

Blumberg RL, Coleman MT. A Theoretical Look at the Gender Balance of Power in the American Couple. Journal of Family Issues. 1989; 10(2):225–250. [PubMed: 12342284]

Breen R, Karlson KB, Holm A. Total, Direct, and Indirect Effects in Logit and Probit Models. Sociological Methods & Research. 2013; 42(2):164–191.

Caspi A, Roberts BW. Personality Development across the Life Course: The Argument for Change and Continuity. Psychological Inquiry. 2001; 12(2):49–66.

Caspi A, Shiner RL. Personality Development. Handbook of Child Psychology III. 2006:6.

Chandra, A., Martinez, GM., Mosher, WD., Abma, JC., Jones, J. Vital Health Statistics. Vol. 23. Hyattville, MD: National Center for Health Statistics; 2005. Fertility, Family Planning, and the Reproductive Health of U.S. Women: Data from the 2002 National Survey of Family Growth.

D'Angelo DV, Gilbert BC, Rochat RW, Santelli JS, Herold JM. Differences between Mistimed and Unwanted Pregnancies among Women Who Have Live Births. Perspectives on Sexual and Reproductive Health. 2004; 36(5):192–197. [PubMed: 15519961]

DiPrete TA, Eirich GM. Cumulative Advantage as a Mechanism for Inequality: A Review of Theoretical and Empirical Developments. Annual Review of Sociology. 2006; 32:271–297.

Donnellan MB, Oswald FL, Baird BM, Lucas RE. The Mini-IPIP Scales: Tiny-yet-effective measures of the Big Five Factors of Personality. Psychological Assessment. 2006; 18(2):192–203. [PubMed: 16768595]

Edin, K., Kefalas, M. Promises I Can Keep: Why Poor Women Put Motherhood Before Marriage. Berkeley: University of California Press; 2005.

Elder GH Jr. The Life Course as Developmental Theory. Child Development. 1998; 69(1):1–12. [PubMed: 9499552]

Finer LB, Henshaw SK. Disparities in Rates of Unintended Pregnancy In the United States, 1994 and 2001. Perspectives on Sexual and Reproductive Health. 2006; 38(2):90–96. [PubMed: 16772190]

Finer LB, Zolna MR. Declines in Unintended Pregnancies in the United States, 2008–2011. New England Journal of Medicine. 2016; 374:843–852. [PubMed: 26962904]

Frost JJ, Singh S, Finer LB. Factors Associated with Contraceptive Use and Nonuse, United States, 2004. Perspectives on Sexual and Reproductive Health. 2007; 39(2):90–99. [PubMed: 17565622]

Gipson JD, Koenig MA, Hindin MJ. The Effects of Unintended Pregnancy on Infant, Child, and Parental Health: A Review of the Literature. Studies in Family Planning. 2008; 39(1):18–38. [PubMed: 18540521]

Guilkey, D., Lance, P. Program Impact Estimation with Binary Outcome Variables: Monte Carlo Results for Alternative Estimators and Empirical Examples. In: Sickles, Horrace, editors. Festschrift in Honor of Peter Schmidt. Vol. 2014. Springer; New York: 2014. p. 5-46.

Guzman L, Wildsmith E, Manlove J, Franzetta K. Unintended Births: Patterns by Race and Ethnicity And Relationship Type. Perspectives on Sexual and Reproductive Health. 2010; 42(3):176–185. [PubMed: 20928956]

Guzzo KB, Hayford SR. Fertility following an unintended first birth. Demography. 2011; 48(4):1493–1516. [PubMed: 21842326]

Guzzo KB, Hayford SR. Unintended Fertility and the Stability of Coresidential Relationships. Social Science Research. 2012; 41(5):1138–1151. [PubMed: 23017923]

Harris KM. An Integrative Approach to Health. Demography. 2010; 47(1):1–22. [PubMed: 20355681]

Harris, KM. The Add Health Study: Design and Accomplishments. 2013. [WWW document: http://www.cpc.unc.edu/projects/addhealth/data/guides/DesignPaperWIIV.pdf]

Hayford SR, Guzzo KB. Age, Relationship Status, and the Planning Status of Births. Demographic Research. 2010; 23(13):365–398.

Hayford SR, Morgan SP. Religiosity and Fertility in the United States: The Role of Fertility Intentions. Social Forces. 2008; 86(3):1163–1188.

Heckman, JJ. Studies in labor markets. University of Chicago Press; 1981. Heterogeneity and state dependence; p. 91-140.

Heckman JJ. Identifying the Hand of Past: Distinguishing State Dependence from Heterogeneity. The American Economic Review. 1991; 81(2):75–79.

Heckman JJ, Borjas GJ. Does unemployment cause future unemployment? Definitions, questions and answers from a continuous time model of heterogeneity and state dependence. Economica. 1980; 47(187):247–283.

Heckman J, Singer B. A method for minimizing the impact of distributional assumptions in econometric models for duration data. Econometrica: Journal of the Econometric Society. 1984:271–320.

Herd P, Higgins J, Sicinski K, Merkurieva I. The Implications of Unintended Pregnancies for Mental Health in Later Life. American Journal of Public Health. Forthcoming.

Johnson-Hanks, J., Bachrach, C., Morgan, SP., Kohler, H-P. Understanding Family Change and Variation: Structure, Conjuncture, and Action. New York: Springer; 2011.

Jokela M, Keltikangas-Jarvinen L. Adolescent leadership and adulthood fertility: Revisiting the "Central theoretical problem of human sociobiology. Journal of Personality. 2009; 77(1):213–230. [PubMed: 19077000]

Jokela M, Alvergne A, Pollet TV, Lumma V. Reproductive behavior and personality traits of the Five factor model. European Journal of Personality. 2011; 25:487–500.

Jones, RK., Kost, K. Reporting of induced and spontaneous abortion in the 2002 National Survey of Family Growth. Presented at the National Center for Health Statistics National Survey of Family Growth Research Conference; Bethesda, MD. October 19th–20th; 2006.

Joyner K, Peters HE, Hynes K, Sikora A, Taber JR, Rendall MS. The quality of male fertility data in major US surveys. Demography. 2012; 49(1):101–124. [PubMed: 22203451]

Kane JB, Morgan SP, Harris K, Guilkey D. The Educational Consequences of Teen Childbearing. Demography. 2013; 50(6):2129–2150. [PubMed: 24078155]

Karlson KB, Holm A, Breen R. Comparing Regression Coefficients Between Same-sample Nested Models Using Logit and Probit A New Method. Sociological Methodology. 2012; 42(1):286–313.

Kirby, D. Antecedents of adolescent initiation of sex, contraceptive use, and pregnancy…. American Journal of Health Behavior; Proceedings of the 2nd Scientific Meeting of the American Academy of Health Behavior; March 24–27, 2002; Napa Valley, CA. 2002. p. 473-485.

Kissin DM, Anderson JE, Kraft JM, Warner L, Jamieson DJ. Is There a Trend of Increased Unwanted Childbearing Among Young Women in the United States? Journal of Adolescent Health. 2008; 43(4):364–371. [PubMed: 18809134]

Kost K, Lindberg L. Pregnancy Intentions, Maternal Behaviors, and Infant Health: Investigating Relationships with New Measures and Propensity Score Analysis. Demography. 2015; 52:83–111. [PubMed: 25573169]

Lindberg L, Maddow-Zimet I, Kost K, Lincoln A. Pregnancy Intentions and Maternal and Child Health: An Analysis of Longitudinal Trends in Oklahoma. Maternal and Child Health Journal. 2015; 19:1087–1096. [PubMed: 25287250]

Logan, C., Holcombe, E., Manlove, J., Ryan, S. A White Paper prepared by Child Trends for the National Campaign to Prevent Teen Pregnancy. Washington, DC: Child Trends; 2007. The Consequences of Unintended Childbearing.

Luker, K. Abortion and the Politics of Motherhood. Berkeley, CA: University of California Press; 1985.

McCrory C, McNally S. The Effect of Pregnancy Intention on Maternal Prenatal Behaviours and Parent and Child Health: Results of an Irish Cohort study. Paediatric and Perinatal Epidemiology. 2013; 27:208–215. [PubMed: 23374066]

McDade TW, Chyu L, Duncan GJ, Hoyt LT, Doane LD, Adam EK. Adolescents' expectations for the future predict health behaviors in early adulthood. Social Science & Medicine. 2011; 73(3):391–398. [PubMed: 21764487]

McLanahan S. Diverging Destinies: How Children Are Faring under the Second Demographic Transition. Demography. 2004; 41(4):607–627. [PubMed: 15622946]

Miller WB. Personality traits and developmental experiences as antecedents of childbearing motivation. Demography. 1992; 29(2):265–285. [PubMed: 1607052]

Miller JD, Lynam D, Zimmerman RS, Logan TK, Leukefeld C, Clayton R. The utility of the Five Factor Model in understanding risky sexual behavior. Personality and Individual Differences. 2004; 36(7):1611–1626.

Morgan SP, Rindfuss RR. Reexamining the Link of Early Childbearing to Marriage and to Subsequent Fertility. Demography. 1999; 36(1):59–75. [PubMed: 10036593]

Mosher, WD., Jones, J., Abma, JC. National Health Statistics Reports No. 55. Hyattsville, MD: National Center for Health Statistics; 2012. Intended and unintended births in the United States: 1982–2010.

Mroz TA. Discrete factor approximations in simultaneous equation models: Estimating the impact of a dummy endogenous variable on a continuous outcome. Journal of Econometrics. 1999; 92(2):233–274. [PubMed: 12322578]

Musick K, England P, Edgington S, Kangas N. Education Differences in Intended and Unintended Fertility. Social Forces. 2009; 88(2):543–572.

Pulley L, Klerman LV, Tang H, Baker BA. The Extent of Pregnancy Mistiming and Its Association with Maternal Characteristics and Behaviors and Pregnancy Outcomes. Perspectives on Sexual and Reproductive Health. 2002; 34(4):206–211. [PubMed: 12214911]

Raffaelli M, Crockett LJ. Sexual Risk Taking in Adolescence: The Role of Self-Regulation and Attraction to Risk. Developmental Psychology. 2003; 39(6):1036–1046. [PubMed: 14584983]

Rindfuss RR, Guilkey D, Morgan SP, Guzzo KB. Child Care Availability and Fertility in Norway: Pro-Natalist Effects. Demography. 2007; 44:345–372. [PubMed: 17583309]

Rindfuss RR, Guilkey DK, Morgan SP, Kravdal O. Child care availability and fertility in Norway. Population and Development Review. 2010; 36(4):725–748. [PubMed: 21174867]

Roberts BW, Caspi A, Moffitt TE. The kids are alright: Growth and stability in personality development from adolescence to adulthood. Journal of Personality and Social Psychology. 2001; 81(4):670–683. [PubMed: 11642353]

Rostosky SS, Regnerus MD, Wright MLC. Coital debut: The role of religiosity and sex attitudes in the Add Health Survey. Journal of Sex Research. 2003; 40(4):358–367. [PubMed: 14735410]

Santelli J, Rochat R, Hatfield-Timajchy K, Gilbert BC, Curtis K, Cabral R, et al. The Measurement and Meaning of Unintended Pregnancy. Perspectives on Sexual and Reproductive Health. 2003; 35(2):94–101. [PubMed: 12729139]

Schmitt DP, Shackelford TK. Big Five traits related to short-term mating: from personality to promiscuity across 46 nations. Evolutionary Psychology. 2008; 6:246–282.

Sewell, William H. A Theory of Structure: Duality, Agency, and Transformation. American Journal of Sociology. 1992; 98(1):1–29.

Sewell, William H. Logics of History. Chicago: University of Chicago Press; 2005.

U.S. Department of Health and Human Services. [Accessed 2/1/11] Proposed Healthy People 2020 Objectives, Family Planning. 2009. http://www.healthypeople.gov/2020/topicsobjectives2020/overview.aspx?topicid=13

Wildsmith E, Guzzo K, Hayford SR. Repeat Unintended, Unwanted and Seriously Mistimed Childbearing in the United States. Perspectives on Sexual and Reproductive Health. 2010; 42(1): 14. [PubMed: 20415880]

Williams L, Abma J, Piccinio L. The Correspondence Between Intention to Avoid Childbearing and Subsequent Fertility: A Prospective Analysis. Family Planning Perspectives. 1999; 31(5):220–227. [PubMed: 10723646]

Wooldridge JM. Fixed-effects and related estimators for correlated random-coefficient and treatment-effect panel data models. Review of Economics and Statistics. 2005; 87(2):385–390.

Wu LL, Musick K. Stability of marital and cohabiting unions following a first birth. Population Research and Policy Review. 2008; 27(6):713–727.

Wulfert E, Block JA, Ana ES, Rodriguez ML. Delay of Gratification: Impulsive Choices and Problem Behaviors in Early and Late Adolescence. Journal of Personality. 2002; 70(4):533–552. [PubMed: 12095190]

APPENDIX 1. 20-Item Mini-IPIP

Item	Factor	Text
1	E	Am the life of the party.
2	A	Sympathize with others' feelings.
3	C	Get chores done right away.
4	N	Have frequent mood swings.
5	O	Have a vivid imagination.
6	E	Don't talk a lot (R).
7	A	Am not interested in other people's problems (R).
8	C	Often forget to put things back in their proper place (R).
9	N	Am relaxed most of the time (R).
10	O	Am not interested in abstract ideas (R).
11	E	Talk to a lot of different people at parties.
12	A	Feel others' emotions.
13	C	Like order.
14	N	Get upset easily.
15	O	Have difficulty understanding abstract ideas (R).
16	E	Keep in the background (R).
17	A	Am not really interested in others (R).
18	C	Make a mess of things (R).
19	N	Seldom feel blue (R).
20	O	Do not have a good imagination (R).

Note:

E=Extraversion; A=Agreeableness; C=Conscientiousness; N=Neuroticism; O=Openness; (R)=Reverse Scored Item.

Appendix 2. Evidence for strong unobserved covariates

In Text Tables 3–5, we focus attention on Model 3 and 4 because there is evidence of powerful unobserved covariates. If these factors were not controlled, the legitimacy of our effects of "state dependence" (the causal effect of an unintended birth) would be greatly weakened. Specifically, using the notation for the error terms in equations (1)-(4), the estimated discrete distribution for the unobserved heterogeneity for Model 4 is presented in Table A2-1. As can be seen by the estimated coefficients and standard errors, most of the mass points are highly significant (i.e., different from zero). A likelihood ratio test of test of the null hypothesis that the heterogeneity parameters are jointly zero yields a test statistic of 264.36 with 21 degrees of freedom which yields a p value of essentially zero. This same result is obtained for Model 3 (results not shown here). Thus, there is strong evidence for unobserved, person-specific heterogeneity that could bias other parameters in the model.

Table A2-1

Estimated Heterogeneity Parameters with Standard Errors in Parentheses for Model 4, Tables 3–5.

Probability Weights	First Birth		Second Birth		Third Birth	
	μ_{12}	μ_{13}	μ_{22}	μ_{23}	μ_{32}	μ_{33}
0.34	0.00	0.00	0.00	0.00	0.00	0.00
0.51	−2.25 (0.23)	0.20 (0.09)	0.94 (0.52)	1.43 (0.12)	1.68 (0.80)	2.34 (0.45)
0.09	2.60 (3.55)	6.87 (3.56)	−8.42 (0.87)	−1.59 (0.69)	−8.34 (0.89)	−2.45 (0.56)
0.06	7.99 (1.08)	7.15 (1.09)	0.64 (0.51)	−0.51 (0.24)	−2.54 (1.17)	−2.32 (0.40)

Table A2-2 provides further information on the unobserved heterogeneity distribution, the estimated correlation matrix based on the estimated parameters from Table A2-1. These large correlations (in the error terms across the set of equations) demonstrate the presence and importance of unobserved heterogeneity.

Table A2-2

Correlation Matrix of error terms across equations producing the estimates shown in Tables 3–5.

	First Birth		Second Birth		Third Birth	
	μ_{12}	μ_{13}	μ_{22}	μ_{23}	μ_{32}	μ_{33}
μ_{12}	1.00	0.83	−0.42	−0.78	−0.69	−0.89
μ_{13}	0.83	1.00	−0.71	−0.70	−0.86	−0.77
μ_{22}	−0.42	−0.71	1.00	0.78	0.95	0.69

Appendix 3. Replication using NLSY79

The goal of this set of analyses was to validate Guzzo and Hayford's findings of the strong effect of prior unintended births on subsequent birth intentions using another longitudinal dataset that is similar to the Add Health data. We used data from NLSY79 (National Longitudinal Survey of Youth) followed through the 1990 survey wave. Respondents were 14 to 22 years old at the time of the initial survey in 1979 and as with the Add Health, we restrict our analyses to female respondents. Using the same person-month format, respondents enter the analysis on the month they turned 15 years old, and exit the month of the last interview (or earlier, if they drop out). We included only the main socioeconomic and demographic variables in this analysis, leaving out personality traits, religiosity and educational aspirations for the analyses using the Add Health data.

We constructed variables similar to those used in the Add Health. We used age and age-squared as time-varying variables across all models and time-invariant indicators for whether age at first birth was under 20 years or over 25 years (with the reference being age at first birth between 20 and 24 years) for models predicting second and third birth intentions. Additionally, we include a control for duration since last birth as a time-varying categorical

variable with three categories: duration less than 24 months, and over 48 months, with duration between 24 and 48 months being the reference category. We also include controls for race-ethnicity (non-Hispanic white, black, Hispanic and "other" race women) and education, measured as a time-varying indicator with four categories: less than high school degree (the reference category), high school degree, some college, and college degree. We control for family dynamics by including an indicator variable for family structure (intact family, step family, other family type) and maternal education (less than high school degree, high school degree, some college and college graduate).

We ran two sets of models using the NLSY79: first, we show basic (reduced) models without accounting for unobserved heterogeneity and state dependence; and second, we show the same models after incorporating the effects of unobserved heterogeneity and state dependence. We used multinomial logistic regression with three categories of the dependent variable at parities 1, 2 and 3 – intended birth, unintended birth and no birth. For models predicting intentions at higher-parities (2 and 3), we included the intentions of earlier births as independent variables.

Table A3-1 in this Appendix shows the estimates of an unintended birth (first, second and third) relative to an intended birth. Table A3-2 shows these estimates after the inclusion of heterogeneity parameters. In both sets of models, we find the same pattern of results: an earlier unintended birth substantially increases the risk of a subsequent birth being unintended. Note that these models do not include any of the unobserved personality characteristics that are available in the Add Health data.

Table A3-1

Unintended birth relative to Intended birth with Basic Controls using NLSY79 (relative risk ratios with standard errors in parentheses)

Variable	Model 1 1st Birth	Model 2 2nd Birth	Model 3 3rd Birth
Prior birth intendedness			
First birth unintended		2.66*** (.21)	
First and second birth unintended			3.11*** (.50)
First birth unintended, second birth intended			1.54** (.23)
First birth intended, second birth unintended			1.72*** (.28)
Age	.71*** (.04)	.93 (.07)	1.13 (.11)
Age-squared	1.00*** (.00)	1.00 (.00)	.99 (.00)
Age at first birth (ref: 20–25 years)			
Under 20 years		.91 (.10)	1.10 (.15)
Over 25 years		.58*** (.08)	.89 (.16)
Race (ref: White)			
Black	2.33*** (.18)	2.41*** (.23)	1.97*** (.27)
Hispanic	.85 (.08)	1.03 (.10)	.99 (.14)
Mother's education (ref:did not complete HS)			
High school graduate	1.29 (.19)	1.47* (.25)	1.33 (.29)

Variable	Model 1 1st Birth	Model 2 2nd Birth	Model 3 3rd Birth
Some college	1.16 (.18)	1.34 (.25)	1.34 (.34)
College graduate	.97 (.14)	1.32 (.22)	1.19 (.26)
Family background (ref: Biological parents)			
Step family	1.24* (.13)	1.20 (.15)	1.17 (.20)
Any other family	1.13 (.08)	1.20* (.10)	1.19 (.15)
Respondent's education (ref: Less than high school)			
High school graduate	.94 (.11)	.76* (.08)	.89 (.14)
Some college	1.07 (.15)	.68* (.10)	.73 (.16)
College degree	.75 (.13)	.56** (.10)	.62 (.16)
Missing education	1.02 (.14)	1.15 (.31)	2.74 (.29)
Months since last birth (ref: 24–48 months)			
0–23 months		2.32*** (.21)	1.24 (.17)
>48 months		.87 (.10)	.63*** (.08)

Table A3-2

Unintended birth relative to Intended birth with Basic Controls and Heterogeneity Correction using NLSY79 (relative risk ratios with standard errors in parentheses)

Variable	Model 1 1st Birth	Model 2 2nd Birth	Model 3 3rd Birth
Prior birth intendedness			
First birth unintended		2.43*** (8.5)	-
First and second birth unintended		-	3.39*** (.2)
First birth unintended, second birth intended		-	1.57** (.1)
First birth intended, second birth unintended		-	1.75*** (.1)
Age	.00*** (.0)	.93 (.1)	1.11 (.1)
Age-squared	1.88*** (.0)	1.00 (.0)	1.00 (.0)
Age at first birth (ref: 20–25 years)			
Under 20 years		.91 (.1)	1.07 (.2)
Over 25 years		.51 (.1)	.60** (.2)
Race (ref: White)			
Black	.99 (.1)	1.79*** (.2)	1.95*** (.1)
Hispanic	.55* (.1)	.89 (.1)	.99 (.1)
Mother's education (ref:did not complete HS)			
High school graduate	.23*** (.2)	.43** (.3)	.94 (.2)
Some college	1.17 (.1)	.99 (.1)	1.08 (.2)
College graduate	3.35*** (.2)	2.07** (.3)	1.01 (.2)
Family background (ref: Biological parents)			
Step family	.83 (.1)	1.03 (.1)	1.18 (.2)
Any other family	.70** (.1)	1.00 (.1)	1.23 (.1)
Respondent's education (ref: Less than high school)			

Variable	Model 1 1st Birth	Model 2 2nd Birth	Model 3 3rd Birth
High school graduate	1.38* (.1)	.79 (.1)	.99 (.1)
Some college	2.77*** (.2)	.89 (.2)	.77 (.2)
College degree		.62 (.3)	.59 (.3)
Missing education	1.38* (.2)	1.22 (.3)	3.00 (1.1)
Months since last birth (ref: 24–48 months)			
0–23 months		2.03*** (.1)	1.35** (.1)
>48 months		1.46 (.2)	.52*** (.2)

Table 1

Weighted Descriptive Statistics for Mothers Aged 15–32 in the National Longitudinal Study of Adolescent to Adult Health (Add Health)

Characteristic	%	N
Total women		8,300
Total live births		8,334
Total mothers		4,326
Average number of births		1.93
Percentage with any unintended birth	55.5%	2,375
Percentage with an unintended first birth	46.5%	2,010
Percentage with an unintended second birth	20.6%	891
Percentage with an unintended third birth	8.5%	368
First and second birth intentions		
Both births intended	37.0%	933
1st intended, 2nd unintended	11.3%	284
1st unintended, 2nd intended	28.0%	707
Both births unintended	23.7%	599
Age at 1st birth		
Under 20 years	26.6%	1,151
20–24 years	43.9%	1,899
25–29 years	26.0%	1,125
30 years or older	3.5%	151
Race		
Non-Hispanic White	64.7%	2,801
Black	18.9%	814
Hispanic	11.2%	487
Other	5.2%	224
Mother's Education		
Missing/Less than high school	30.0%	1,283
High school	36.0%	1,571
Some college	18.3%	796
College or more	15.7%	676
Family type		
Intact family	46.9%	2,041
Step family	18.8%	827
Other family	34.2%	1,458
Respondent's education		
Missing	16.4%	709
High school	65.6%	2,838
Less than high school	18.0%	779
Relationship Status at 1st Birth		
Married	44.0%	1,903

Characteristic	%	N
Cohabiting	28.8%	1,246
Not in a coresidential relationship	27.2%	1,177

Table 2

Sample sizes of each birth order estimated in the system of equations in Tables 4–6

Birth order	Total Births	Intended births		Unintended births		No birth of this order
		N	%	N	%	
First	4,607	2,448	53.1	2,159	46.9	8,296
Second	2,727	1,780	65.3	947	34.7	4,560
Third	1,000	590	59.0	410	41.0	2,692
Total	8,334	4,818	57.8	3,516	42.2	

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Table 3

Weighted descriptive statistics for psychosocial variables

Measure	Mean	SD	Range
Conscientiousness	14.8	2.6	4–20
Likely to go to college	4.2	1.1	1–5
Importance of Religion (excludes 1040 missing)	3.4	0.7	1–4

Table 4

Estimated effects of covariates on the likelihood of unintended versus intended birth: First births (Relative Risk Ratios with Standard Errors in parentheses)

Variable	Model 1 Reduced (not accounting for heterogeneity)	Model 2 Full (not accounting for heterogeneity)	Model 3 Reduced (accounting for heterogeneity)	Model 4 Full (accounting for heterogeneity)
Age	2.09*** (.32)	2.05*** (.31)	2.48*** (.13)	2.76*** (.13)
Age-squared	.98*** (.003)	.98*** (.003)	.98*** (.003)	.98*** (.003)
Race (ref: White)				
Black	1.33* (.15)	1.43** (.16)	1.32* (.10)	1.50** (.10)
Hispanic	1.07 (.15)	1.07 (.15)	1.10 (.10)	1.06 (.11)
Other race	1.27* (.20)	1.31 (.20)	1.42* (.13)	1.39* (.13)
Mother's education (ref:missing/did not complete HS)				
High school graduate	1.05 (.11)	1.06 (.11)	1.04 (.09)	1.04 (.09)
Some college	1.07 (.13)	1.09 (.13)	.97 (.11)	.97 (.11)
College graduate	.96 (.12)	1.00 (.13)	.89 (.11)	.87 (.11)
Family background (ref: Biological parents)				
Step family	1.41** (.15)	1.41** (.15)	1.38** (.09)	1.40** (.09)
Any other family	1.26* (.12)	1.24* (.12)	1.20* (.09)	1.24* (.09)
Respondent's education				
High school graduate	.99 (.12)	1.02 (.12)	.99 (.11)	1.02 (.11)
Missing education response	1.05 (.16)	1.05 (.17)	1.08 (.12)	1.06 (.12)
Union status at birth (ref:not in a coresidential relationship)				
Married	.21*** (.03)	.21*** (.03)	.26*** (.11)	.27*** (.11)
Cohabiting	.66** (.09)	.65** (.09)	.70** (.09)	.70** (.10)
Personality characteristics				
Respondent aspires to attend college		.96 (.03)		.92* (.04)
Conscientious		.96* (.01)		0.98 (.01)
Religiosity				
Very important		.78** (.06)		.81* (.12)
Missing religion response		.78* (.10)		.85 (.12)
Person-months	997839	997839	997839	997839
Number of women	8000	8000	8000	8000
Log likelihood[a]	−665,185	−665,125	−665,088	−664,993

*** p<0.001,

** p<0.01,

* p<.05

Note:

[a]The estimated log likelihood is for the full multi-equation model, i.e., including all estimates in Tables 4–6 as well as effects on the contrast of (intended & unintended) births versus no birth.

Table 5

Estimated effects of covariates on the likelihood of unintended versus intended birth: Second births (Relative Risk Ratios with Standard Errors in parentheses)

Variable	Model 1 Reduced (not accounting for heterogeneity)	Model 2 Full (not accounting for heterogeneity)	Model 3 Reduced (accounting for heterogeneity)	Model 4 Full (accounting for heterogeneity)
First birth unintended	2.04*** (.26)	2.01*** (.25)	2.96*** (.21)	3.13*** (.37)
Age	.84 (.19)	.84 (.19)	.92 (.19)	.97 (.21)
Age-squared	1.00 (.004)	1.00 (.004)	1.00 (.002)	1.00 (.002)
Age at first birth (ref: 20–25 years)				
Under 20 years	.89 (.16)	.91 (.17)	.87 (.13)	.88 (.13)
Over 25 years	.65 (.18)	.65 (.18)	.72 (.19)	.73 (.19)
Race (ref: White)				
Black	1.47** (.21)	1.58** (.23)	1.55*** (.11)	1.72** (.13)
Hispanic	1.20 (.17)	1.19 (.17)	1.20 (.12)	1.20 (.12)
Other race	.68 (.17)	.71 (.17)	1.13 (.17)	1.15 (.17)
Mother's education (ref:missing/did not complete HS)				
High school graduate	1.11 (.18)	1.16 (.19)	1.02 (.10)	1.07 (.11)
Some college	1.09 (.19)	1.19 (.21)	1.05 (.13)	1.07 (.13)
College graduate	1.04 (.21)	1.15 (.24)	1.25 (.14)	1.32 (.14)
Family background (ref: Biological parents)				
Step family	1.05 (.14)	1.03 (.14)	1.04 (.11)	1.04 (.12)
Any other family	1.03 (.13)	.99 (.13)	1.12 (.10)	1.14 (.11)
Respondent's education				
High school graduate	.93 (.12)	1.00 (.14)	.83 (.11)	.88 (.11)
Missing education response	1.01 (.17)	1.06 (.18)	.95 (.13)	.99 (.14)
Months since last birth (ref: 24–48 months)				
0–23 months	2.55*** (.40)	2.56*** (.41)	2.29*** (.11)	2.34*** (.11)
>48 months	.96 (.16)	.94 (.15)	1.02 (.12)	1.03 (.12)
Union status at birth (ref: not in a coresidential relationship)				
Married	.24*** (.04)	.25*** (.04)	.24*** (.13)	.24*** (.14)
Cohabiting	.62** (.09)	.63** (.09)	.58*** (.12)	.58*** (.13)
Personality characteristics				
Respondent aspires to attend college		.88** (.04)		.92 (.04)
Conscientious		.96* (.02)		.95* (.01)
Religiosity (ref: not important at all)				
Very important		.94 (.10)		.85 (.09)
Missing religion response		.92 (.16)		.86 (.14)
Person-months	217936	217936	217936	217936
Number of mothers	2554	2554	2554	2554

Variable	Model 1 Reduced (not accounting for heterogeneity)	Model 2 Full (not accounting for heterogeneity)	Model 3 Reduced (accounting for heterogeneity)	Model 4 Full (accounting for heterogeneity)
Log likelihood[a]	−665,185	−665,125	−665,088	−664,993

*** p<0.001,

** p<0.01,

* p<.05

Note:

[a]The estimated log likelihood is for the full multi-equation model, i.e., including all estimates in Tables 4–6 as well as effects on the contrast of (intended & unintended) births versus no birth.

Table 6

Estimated effects of covariates on the likelihood of unintended versus intended birth: Third births (Risk Ratios with Standard Errors in parentheses)

Variable	Model 1 Reduced (not accounting for heterogeneity)	Model 2 Full (not accounting for heterogeneity)	Model 3 Reduced (accounting for heterogeneity)	Model 4 Full (accounting for heterogeneity)
Prior birth intendedness (ref: First and second births intended)				
First and second birth unintended	3.91*** (.78)	3.83*** (.77)	4.94*** (.28)	25.63*** (.58)
First birth intended, second birth unintended	2.93*** (.71)	2.89*** (.71)	2.89*** (.27)	2.25*** (.37)
First birth unintended, second birth intended	1.43 (.29)	1.44 (.28)	1.78 (.31)	5.89* (.59)
Age	1.38 (.52)	1.39 (.53)	1.29 (.35)	1.08 (.36)
Age-squared	.99 (.01)	.99 (.01)	.99 (.01)	.99 (.01)
Age at first birth (ref: 20–25 years)				
Under 20 years	1.13 (.19)	1.15 (.19)	1.07 (.16)	.88 (.19)
Over 25 years	1.26 (.54)	1.24 (.53)	1.43 (.44)	1.92 (.46)
Race (ref: White)				
Black	1.31 (.23)	1.32 (.24)	1.26 (.17)	1.04 (.21)
Hispanic	1.13 (.22)	1.14 (.22)	1.14 (.19)	1.22 (.21)
Other race	1.02 (.29)	1.04 (.29)	.98 (.27)	1.02 (.30)
Mother's education (ref:missing/did not complete HS)				
High school graduate	1.25 (.19)	1.27 (.21)	1.14 (.16)	1.20 (.17)
Some college	1.15 (.23)	1.17 (.25)	1.17 (.25)	1.36 (.24)
College graduate	.97 (.23)	.98 (.23)	.95 (.23)	1.18 (.27)
Family background (ref: Biological parents)				
Step family	1.20 (.22)	1.17 (.22)	1.09 (.19)	.97 (.21)
Any other family	1.02 (.17)	1.03 (.17)	1.01 (.16)	.93 (.17)
Respondent's education				
High school graduate	.97 (.17)	.97 (.17)	1.02 (.17)	1.14 (.19)
Missing education response	1.27 (.26)	1.27 (.27)	1.25 (.21)	1.37 (.23)
Months since last birth (ref: 24–48 months)				
0–23 months	1.87*** (.31)	1.88*** (.31)	1.87*** (.16)	1.91*** (.17)
>48 months	.75 (.14)	.73 (.14)	.76 (.19)	.69 (.21)
Union status at birth (ref: not in a coresidential relationship)				
Married	.30*** (.07)	.30** (.07)	.30*** (.22)	.22*** (.27)
Cohabiting	.60* (.13)	.59* (.13)	.59*** (.21)	.53** (.23)
Personality characteristics				
Respondent aspires to attend college		.99 (.05)		1.08 (.07)
Conscientious		.94* (.02)		.95 (.02)

Variable	Model 1 Reduced (not accounting for heterogeneity)	Model 2 Full (not accounting for heterogeneity)	Model 3 Reduced (accounting for heterogeneity)	Model 4 Full (accounting for heterogeneity)
Religiosity (ref: not important at all)				
Very important		1.02 (.16)		1.08 (.17)
Missing religion response		.81 (.17)		.88 (.24)
Person-months	109201	109201	109201	109201
Number of mothers	914	914	914	914
Log likelihood[a]	−665,185	−665,125	−665,088	−664,993

*** p<0.001,

** p<0.01,

* p<.05

Note:

[a]The estimated log likelihood is for the full multi-equation model, i.e., including all estimates in Tables 4–6 as well as effects on the contrast of (intended & unintended) births versus no birth.