Differences in intergenerational fertility associations by sex and race in Saba, Dutch Caribbean, 1876–2004

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Differences in intergenerational fertility associations by sex and race in Saba, Dutch Caribbean, 1876–2004

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Abstract

This study examines the intergenerational transmission of fertility behavior in Saba, Dutch Caribbean from 1876 to 2004 using reconstituted genealogies. Pearson product-moment correlation coefficients of several fertility measures and event-history models of age at first birth are used to explore relationships between the fertility of mothers and their children. The strength of intergenerational fertility ties varies by race and gender. Individuals that are better positioned to realize their fertility preferences have the strongest intergenerational associations, while individuals with the most limited reproductive options have the weakest intergenerational associations. This evidence supports hypotheses that posit the intergenerational transmission of attitudes, goals, and behaviors and the ability to act on those preferences as drivers of the presence or magnitude of links between the fertility of parents and their children.

Keywords

intergenerational fertility; Saba; Caribbean; event-history models; fertility preferences

Introduction

The relationship between the fertility of parents and their children has been a subject of study for over a century (Pearson, Lee, & Bramley-Moore, 1899). In this early work, intergenerational fertility was investigated in the British peerage, with a focus on the effects of fertility correlations on population biology. Later investigators would restrict their study of intergenerational fertility to specific periods or populations to control for potential heterogeneity of other traits related to fertility outcomes, and address possible causes of these correlations, including the biological and social transmission of fertility characteristics and behaviors. This study examines the intergenerational transmission of fertility behavior in Saba, Caribbean Netherlands, from 1876–2004. We revisit some common approaches to the study of intergenerational fertility, namely bivariate correlations of fertility measures and event-history models of the timing of births. Reconstituted genealogies from Saba allow us to extend these studies to include topics less frequently addressed in the literature: variation in intergenerational fertility between racial groups within the same population and the connections among family context, race, gender, economic opportunity, and fertility behavior in a highly mobile population.

Background

Before the fertility transition, the intergenerational correlation in fertility appears to be weak (Bocquet-Appel & Jakobi, 1993; Levine, 1982; Neel & Schull, 1972; Pearson et al., 1899) or nonexistent (Desjardins, Bideau, Heyer, & Brunet, 1991; Gagnon &Heyer, 2001; Langford & Wilson, 1985). Yet, studies that focus on populations undergoing the fertility transition (Anderton, Tsuya, Bean, & Mineau, 1987; Reher, Ortega, &Sanz-Gimeno, 2008) and post-transition populations (Axinn, Clarkberg, & Thornton, 1994; Duncan, Freedman, Coble, &Slesinger, 1965; Johnson & Stokes, 1976; McAllister, Stokes, & Knapp, 1974) find stronger correlations. Many authors point to the increasing role of social transmission as an explanation for this trend (Murphy, 1999), as fertility control in transitional or post-transitional populations is entering or has been established in the domain of conscious choice (Coale, 1973). If the fertility transition is a key moment in the growing role of personal choice in fertility decisions, then individuals in transitional or post-transition populations are better able to realize their fertility preferences than those in populations with high fertility regimes where the conscious control of fertility is not a recognized or viable option. Hypotheses concerning the biological transmission of fertility behavior also draw upon notions of increased choice that accompany the fertility transition. Udry (1996) proposed that when individuals gain broader behavior choices and egalitarian opportunities, biological variable explain an increasing portion of variation in behavior. Studies that focus on the genetic component of fertility behavior seem to support this notion, as the heritability of fertility traits varies by both gender and socioeconomic conditions (Kohler, Rodgers, & Christensen 1999; 2002). When a broad range of fertility decisions are possible, the heritability of fertility is higher.

Despite an increasing number of studies with a growing diversity of geographical and temporal contexts, the precise causal mechanisms of intergenerational correlations remain unclear. Twin studies have explored the role of genetic transmission of traits related to fertility outcomes (Murphy & Knudsen, 2002; Kohler, Rodgers, & Christensen, 1999; 2002), while studies using survey data of contemporary populations have primarily focused on the role of social transmission of fertility behavior. For example, family environment and socialization may influence the development of attitudes or preferences concerning fertility behavior (Axinn et al., 1994; Barber, 2000). Other hypothesized social mechanisms for the fertility correlation between parents and children include the transmission of socioeconomic status (Kahn & Anderson, 1992; Pouta, Jarvelin, Hemminki, Sovio, & Hartikainen, 2005; van Poppel, Monden, & Mandemakers, 2008), educational attainment (Barber, 2001), and the timing of marriage or initiation of childbearing (Barber, 2001; Kobrin & Waite, 1984). The intergenerational transmission of socioeconomic status has also been implicated as a cause of the increasing strength of intergenerational fertility during the demographic transition, as economic modernization is often closely tied to declining fertility (Murphy 2012; Cleland & Wilson, 1987; Knodel & van de Walle, 1979).

Family contexts have been shown to affect intergenerational fertility. For instance, the fertility of first-born daughters typically shows greater correlation with their mothers than that of the later-born siblings (Johnson & Stokes, 1976; Reher et al., 2008), although some studies have found no effect of birth order (Murphy & Knudsen, 2002). Feelings of closeness with family are also associated with stronger intergenerational fertility correlations (McAllister et al., 1974). Adult women with a living mother are at higher risk of progressing to another birth than are women whose mothers are deceased, suggesting that mothers have an effect on the fertility of their daughters that extends beyond socialization and the environment of the childhood home (Jennings, Sullivan, & Hacker, 2012). Evolutionary studies of human behavior have also demonstrated the importance of kin on fertility. Often the presence of kin, particularly a woman's mother or mother-in-law has a positive effect on fertility (Hawkes, O'connell, Jones, Alvarez, & Charnov, 1998; Sear & Coall, 2011; Sear, Mace, & McGregor, 2003). The declining presence or availability of kin has also been suggested as a contributing factor to falling fertility during the demographic transition (Newson, Postmes, Lea, &Webley, 2005; Short, Goldscheider, & Torr, 2006).

In this study, we focus on the social and economic influence of the previous generation on the fertility behavior of their children. Particular attention is paid to processes that influence fertility, including migration, economic activities, and family formation, and how they vary by gender and race. Through the examination of differences in intergenerational fertility among siblings, we also explore how family context and the socialization of children may contribute to the adoption of fertility behaviors.

Setting: Saba

Saba provides an attractive setting for the study of intergenerational fertility. Having undergone the fertility transition during the period of study (1876–2004) increases the likelihood that there will be evidence of the transmission of fertility behavior between generations. With a racially heterogeneous population and high levels of both permanent and return labor migration, this population provides a context for the study of intergenerational fertility that shares some characteristics with many contemporary societies. Thus, the results of this study may have implications for future work related to fertility behavior in racially diverse and mobile populations that have undergone the fertility transition. Saba has been visited by both ethnographers, such as Julia Crane (1971) and biological anthropologists (Fry 1981; MacQueen 1989, Soloway 2007). The data used in this study were collected from civil records of births, deaths, and marriagesthat were linked together to form genealogies. Reliable civil registration began in 1876, which marks the beginning of the study period. The original genealogical database, created in the late 1970's, has been updated on several occasions, with the last update occurring in 2004.

Saba is a small island (12 km^2) in the northeast Caribbean. It became a special municipality of the Netherlands after the 2010 dissolution of the Netherlands Antilles. Formed from volcanic activity, the island rises sharply out of the sea and features rugged terrain, making the land unsuitable for plantation cultivation. Despite the absence of plantation agriculture, slavery was present on the island until emancipation in 1863 (Keur & Keur, 1960). However, the slave population did not exceed the free population so that, in contrast to most other Caribbean islands, Saba maintained a majority white population until the mid- to late-twentieth century.

There are four inhabited villages on Saba. In order of population, they are The Bottom, Windwardside, Hell's Gate, and St. Johns. Mary's Point, a fifth village, was abandoned in 1930s following a hurricane. In the past, villages were relatively isolated and most couples chose to settle in their village of birth. As transportation on the island improved after the construction of roads and import of automobiles, village endogamy decreased (Fry, 1981).

Saban economy and labor migration—Most inhabitants of Saba were small-scale farmers, sailors, fishermen, boat builders, or craftsmen, even into the twentieth century. Later, remittance money became an important source of income (Crane, 1971). Labor migration has been an important aspect of the livelihood of many Sabans. The migration history of the island can be divided into three primary phases defined by patterns in economic activities and type of migration (Crane, 1971; 1987; Fry, 1981; MacQueen, 1989). The first phase was characterized by seafaring. Men would leave the island to find work as sailors, fishermen, navigators, and captains. Typically, the men who migrated would return periodically to Saba to marry or visit their families. Sailing trips could keep them away for a few months to several years at a time. Few men migrated with their families, who usually remained on island. These economic opportunities favored white males, who were better able to obtain work on foreign-owned vessels. In addition, Saban men who owned or captained ships were typically of the white elite of the island. These higher-status individuals were more likely to migrate with their families, who settled in larger ports in the Caribbean or in the United States.

In 1914, oil was discovered near Lake Maracaibo in Venezuela, and many Sabans began to migrate to take advantage of new labor opportunities in the oil industry. During this second phase of labor migration, both white and black men moved to islands near the oil fields and refineries for work. These men would seldom bring their families along, but would visit home from time to time. With so many men gone from the island, agriculture and fishing, activities considered men's work, declined and the dependence of the island's economy on remittance money increased (Crane, 1971). The sex-specific labor migration associated with the oil industry skewed the sex ratio on Saba, so that for a time it was known as an "island of women." In 1937, it is estimated that there were 169 females for every 100 males on Saba (Crane, 1971, p. 72).

While both black and white men migrated for oil work, there were some differences between the races in the type of work performed and the length of time spent away from home. During the oil phase, the labor migration trips of black males were longer than those of their white counterparts. The destinations of labor migrants also varied by race. Black men preferred to work in other Dutch islands, while whites travelled more frequently to non-Dutch islands (MacQueen, 1989). This oil phase saw the population of Saba peak at 2448 in 1914, after which out-migration and decreasing fertility contributed to dramatic population decline. In 1920, six years later, the population numbered only 1655. In 2004, the population of Saba was 1386, of which 832 were of Saban heritage, while many of the non-Sabans were associated with a medical school that was established on the island in 1986.

By the 1960's, increased mechanization of oil production led to layoffs, and many oil workers returned home to Saba. This marked the third phase in Saba's migration history. With few economic opportunities at home, many individuals and families began to leave the island permanently. Among the most likely to leave were educated young people and black men and women, who were hit particularly hard by the layoffs in the oil industry (Fry, 1981; MacQueen, 1989). White women were never involved in labor migration at any stage in Saba's history, and they seldom left the island or worked outside of their homes. Handicrafts, such as drawn-lace work, were among the few economic activities available to them. In contrast, black women had more opportunities to work outside of the home, both on Saba and elsewhere, and they were more mobile as a result. Often these women would take domestic work, either for wealthier families on Saba, or in households on other islands.

Temporary or extended labor migration can influence fertility patterns, especially as unions are disrupted, marriages are delayed, or entire families leave the area. Some of these effects have been documented in other populations subject to migration flows. Studies of a Portuguese parish, Swiss canton, and Mexican community demonstrate that the out-migration of males reduces fertility (Brettell, 1986; Massey & Mullan, 1984; Van de Walle, 1975). In these cases, the temporary absence of a spouse reduces the risk of conception and lengthens birth intervals. In cases of temporary migration, seasonal labor patterns contribute to a seasonal pattern of births, as spouses are united for only certain times during the year. On Saba, similar processes may have been at work. Among those women who reproduced, the average number of children was low, even in the early birth cohorts. For example, among the 1876–1895 birth cohort, the average completed family size of women who reproduced was 4.05, while for those in the 1895–1915 birth cohort it was 3.49 (Fry, 1981, p. 49). With respect to intergenerational fertility, the extended absence of spouses from Saba may dampen intergenerational influences on fertility, as couples may not have been able to achieve their desired fertility because of long absences. Yet, in her study of migration in Saba, MacQueen (1989) argues that migration itself is a multigenerational process. Gagnon and colleagues (2006) demonstrate that men's propensity to migrate is transmitted through the generations, and that it associated with paternal inheritance and patrilocal postmarital residence. Thus, migration, and the economic opportunities it provides, may contribute to intergenerational fertility, just as the intergenerational transmission of other factors, such as socioeconomic status or educational status, have also been linked to fertility behavior (Barber, 2001; Kahn & Anderson, 1992; van Poppel et al., 2008).

Family formation on Saba—The process of migration is closely linked to family formation on Saba. Traditionally, Sabans practiced neolocal residence, the establishment of a new household at the time of marriage. A house and an income were therefore prerequisites for marriage (Crane, 1971). To meet these requirements, many young men married after their first employment, which was usually off-island (Crane, 1971). However, young adults needed to obtain permission from their parents to leave the island for work, and families could refuse to "free" their children (Keur & Keur, 1960). In some cases, the youngest daughter was required to stay at home to care for her parents as they aged. These women typically remained unmarried, as families could exert considerable influence upon their unmarried daughters. Three-generation households were therefore rare (Keur & Keur, 1960). This practice also contributed to the high instance of permanent celibacy, the condition of having never married and never had children, especially among white women (Crane, 1971).

The skewed sex ratio on the island, combined with a decreasing population, presented challenges for those looking for prospective marriage partners (Crane, 1971; Fry, 1981). It could be particularly difficult for women to find a suitable mate. The high instance of permanent celibacy among Saban women is also attributable in part to the lack of marriageable men. Fry (1981) estimates that between 46 and 59 percent of the female population never married and never reproduced on the island. However, her figures regarding permanent celibacy are biased by out-migration. They represent the females on Saba who were single as well as those who were single at the time they left the island. The possible marriage and reproduction of these single migrants are not reflected in the data available on Saba, thus inflating the estimates of permanent celibacy. Using the sample drawn for this study, if we restrict our calculations to those women with a death record on island so that permanent out-migrants are not included, 37 percent of white women never married and never had children, while 26 percent of black women remained celibate.

In the past, interracial unions were rare, usually comprising less than ten percent of all marriages (Fry, 1981, p. 56). The practice remained uncommon until very recently, when the percentage of interracial marriages reached twenty percent in the 2000s (A. E. Sullivan, 2006, p. 641). However, these recently married individuals are not included in the following analyses because they had not completed their childbearing years by the time of the last data collection in 2004. Divorce and cohabitation were rare. Although extramarital and informal unions were common, they were outnumbered by formal unions (Crane, 1971; Keur & Keur, 1960). Among informal or extramarital unions, the most common type was a "visiting" union, in which the partners did not cohabitate. Unfortunately, such informal unions are not recorded in the data, so it is not possible to assess the effect of these unions on the intergenerational transmission of fertility separately from all non-marital fertility. Despite these forms of non-martial fertility, few children on Saba were considered illegitimate, as marriage was not considered a requirement for legitimacy; rather, recognition by the father defined legitimate status in this society (Fry, 1981). Cultural definitions aside, the records of

16.9 percent of mother-child pairs in the sample used in the analyses to follow had missing information on the identity of the father. Thus, the total fertility of males is underestimated.

As in the case of migration, family formation practices also vary by race. In her study of Saban family and migration history, Sullivan (2006) argues that black and white women pursued different family-building strategies. Although practices varied over time and across village contexts, some generalizations can be made. For white women, strong social prohibitions against non-marital childbearing existed until recent years. Thus, most white women had their children within the context of marriage. In times of male-dominated labor migration and skewed sex ratios on the island, this social expectation contributed to high levels of permanent celibacy for these women. In the period immediately following emancipation, black families placed similar emphasis on martial childbearing (A. E. Sullivan, 2006). Unlike white women, black women's family formation practices changed over time. These women began to pursue a mixed set of childbearing strategies that included exclusively marital childbearing, a mix of non-martial and marital childbearing, and exclusively non-martial childbearing.

Data

Genealogical data were initially collected from Saba's civil records of births, deaths, and marriages by Peggy Fry and Paul Leslie in 1977 (Fry, 1981). These records were checked against Anglican Church records of baptisms, marriages, and burials, and the ongoing household census for errors, inconsistencies, and missing data. Individuals were assigned unique identification numbers and birth, death and marriage records were linked to create genealogies. The original wave of data collection covered the years 1876, when reliable vital registration began, to 1977, the year of the first round of demographic data collection (Fry, 1981). Several subsequent updates to the database have occurred, expanding data coverage until 2004 (MacQueen, 1989; Soloway, 2007; A. E. Sullivan, 2006). Additional information about place names, local history, and family histories were gathered during interviews and incorporated into the genealogical database.

The civil records do not list information about race, so individuals were assigned a racial code though a series of steps (Fry, 1981). First, individuals whose race was known from interview data were assigned a racial code. Then, a computer program assigned individuals of unknown racial descent to the same code as their relatives of known descent or to a mixed code if parents were of known and differing races. Each run through the genealogies assigned racial codes to individuals more distantly related to the original individuals of known descent.

To construct the database used in this study, mothers and children were linked using family and relationship identifiers. For the purposes of this study, children sharing the same mother are considered part of one sibling group. Thus, family size is determined by total maternal fertility so that the children of any partnership are included in fertility measures related to the previous generation. This specification allows children without identified fathers to be included in the analysis. It may also better represent the family context in which children are socialized, as children were more likely to reside with their mother, regardless of the identity of their father (MacQueen, 1989; A. E. Sullivan, 2006).

Mothers who did not survive until the end of their childbearing years, defined as age 50, were excluded from the sample. The fertility outcomes of children who did not survive until age 50 were also excluded from the analysis. However, children that did die before age 50 were included in their mother's total fertility measurements. Although men may produce children after age 50, the majority of their fertility behavior occurs before this age, so we keep this selection criterion to facilitate comparisons by sex.[1] These selection criteria ensure that mothers and children survived through their fertile years. This process favors healthy mothers and healthy children. If health affects fertility, and if the health of mothers and their children are correlated, then estimates of intergenerational correlations in fertility are likely to be biased upward. The selection of mother-child pairs that survive until age 50 ensures that comparisons are made among individuals who have had similar opportunity to reproduce in the sense that they survived through their reproductive years. However, this only accounts for a portion of the relationship between fertility and health, which still may bias the results reported here. Finally, these age-based selection criteria eliminate individuals who permanently migrated from Saba before the end of childbearing years. It is not possible to account for spells of temporary migration using the available data.

Unlike many prior studies of intergenerational fertility, this sample is not restricted to married individuals or those with uninterrupted marital histories, such as those who never divorced or whose partner did not precede them in death. With an increasing incidence of divorce and non-marital childbearing, such a sample restriction is neither practical nor appropriate given our interest in total fertility rather than marital fertility. Even if only individuals with uninterrupted marital histories were included, the common practice of labor migration would ensure that many of those unions were interrupted by the absence of a spouse for a period of months or years. In addition, since the Saba genealogical database contains relatively complete life histories for individuals regardless of marital or fertility status, it is unlikely that such selection criteria would improve the quality of data in the sample.

With these criteria, 2,728 mother-child pairs were identified among a total of 5440 pairs.[2] Of these pairs, 1,507 were white and 1,221 were black. Individuals of mixed race, known as colored in local parlance, were excluded from the sample. While the exclusion of mixed-race individuals simplifies the realities of race and social identity on the island, this simplification is useful for the comparative purposes of these analyses. There are too few cases of mixed-race individuals to support separate analysis by race and sex. Including them in either the white or the black category would introduce heterogeneity that could bias results related to intergenerational correlations within that group. In analyses not reported here, the addition of mixed ancestry to either the white or black group increased the bivariate intergenerational correlations from between 0.026 to .001, depending on the measurement and race-sex group in question.

Migration is an important aspect of population dynamics on Saba. Labor migration of short or long duration and permanent out-migration were common practices. Unfortunately, the available data do not specify the beginning or end of an individual's absence from the island. The data used by MacQueen (1989) covers only a small portion of the period of interest, as she relied of records of departures and arrivals on island from 1929–1930 and 1951–1976. Unobserved migration may bias some of the results of the analysis of intergenerational fertility. The fertility of migrants that takes place off-island is unknown unless the child later returned to Saba and appeared in other records used in the family reconstitution. In addition, the temporary or permanent absence of a spouse disrupts marital unions and may result in lower fertility. Finally, migration is selective with respect to many dimensions, so it could reasonably be expected that migrants and non-migrants may vary in ways that might relate to their fertility behavior (Constant & Massey, 2003; Kulu, 2005; Massey et al., 1993).

[1]In analyses not reported here, extending the mortality criteria for males until age 60 did not significantly change the results.

[2]2209 did not meet the age criteria, having either died or emigrated before completing their childbearing years. 503 of the remaining were of mixed ancestry.

Without substantial simulation or sensitivity analyses, it is difficult to determine in which direction or to what extent migration, or other potentially inherited traits, may influence the results presented here. Even simulations must rely upon a set of assumptions that may not be realistic. One may imagine instances where the transmission of traits such as wealth may inflate the estimates of intergenerational fertility. In other cases, the transmission of less permissive social contexts and behavioral expectations may contribute to lower estimates. Gender and race are also possible factors, as one might expect that the potential intergenerational patterns of migration may bias the estimates for men more than for women, as men were more mobile in this society. The transmission of wealth may be more of a factor for whites than blacks, as the socioeconomic elites of Saba were predominantly white. The possible effects of unobserved variation in both individual and intergenerational traits are important when interpreting the results of the analyses that follow.

Methods

Several indicators of fertility behavior are calculated for index individuals and their mothers. These measures include total number of children ever born (CEB), age at first birth, age at last birth, age at first marriage, span of childbearing years (age at last birth minus age at first birth), and intensity of childbearing (span of childbearing years divided by CEB). These variables are transformed into cohort-relative measures by subtracting the individual observation of a variable from the average of that variable from women or men born within a 10-year window of the person of interest.[3] Relative measures are calculated separately for women and men, as the sexes tend to vary in the timing of many of the events of interest, such as age at first marriage and age at first birth. This method accounts for temporal trends, such as the overall decline in fertility, without specifying a single set of fixed periods. Categorical variables are coded from linked records and include race and marital status (1=ever married). Finally, birth order is measured from siblings that share the same mother (1=firstborn, 2=second born, etc.), both overall and by sex (firstborn son, firstborn daughter, etc.). To maintain the mutually exclusive character of firstborn and non-firstborn categories, single children are grouped with firstborn children. The relative fertility measures calculated for index people and their mothers are compared using Pearson product-moment correlation coefficients. *P*-values are adjusted for multiple testing using the Bonferroni method.

Heterogeneity in the sample may inflate these correlation coefficients. Therefore, we also examine relative CEB, the most consistently statistically significant fertility measure found in the bivariate correlations, in a generalized least squares (GLS) model. The index person's cohort relative CEB is the outcome variable and predictors include race, sex, whether firstborn, year of birth, and mother's cohort relative CEB. Sibling random effects account for unobserved heterogeneity at the family level. The Breusch-Pagan Lagrange multiplier (LM) test and Hausman test each indicate that random effects were appropriate.

The timing of births is an aspect of fertility behavior that has been found to have an intergenerational component (Jennings et al., 2012; Reher et al., 2008). Cox proportional hazard models are fit for age at first birth for index individuals (Cox, 1972). Event-history models relate the time until an event occurs, in this case a first birth, to a set of covariates. Proportional hazard models are a class of event-history models in which time is treated as a continuous, rather than discrete, function and no assumptions are made about the form of the baseline hazard function, although the effects of covariates are assumed to be proportional to the baseline hazard.

[3]A 4-year window was also tested. The results were not significantly different than those reported here, although the averages were less stable than those obtained using a 10-year window at the beginning and end of the study period as would be expected with the reduced number of cases in each of the shorter windows.

In this analysis, the same relative fertility measures are used in combination with other variables, including a period measure (index person's birth year). Time varying covariates, such as the vital status of the mother and father (1=dead), marital status of the index person (1=married), and age of index person are also included. Of these time-varying measures, the vital status of the mother and father and the marital status of the index person violated the proportional hazards assumption. These terms were interacted with the natural log of analysis time, which corrected the proportionality of hazards. Individuals who did not experience a birth event are right-censored at their fiftieth birthday. A combined model and models stratified by race and sex, which allow the baseline hazards to vary freely for each group, are reported. A sibling random effects, or shared frailty, term is included to account for unobserved heterogeneity at the family level.

This approach to the analysis of intergenerational effects on fertility has several advantages over bivariate correlations. By allowing for the censoring of cases, this approach reduces the possible biases associated with unobserved migration. This method considers timing of events, in this case the time to first birth, while also accounting for other time-varying and constant covariates and family-specific random effects. All calculations and models were performed using Stata 12 (StataCorp, 2011). The sample described in the data section was used for the bivariate correlations, GLS random effects models, and Cox hazard models.

Results

Bivariate correlations and random effects model

Men and women from larger families are more likely to have larger families themselves, relative to their age-graded peers (Table 1). Of the other fertility indicators examined, only the age at last childbirth is significant, and only for men. When the sample is divided by race and sex, and the correlation coefficients are recalculated, it is clear that the fertility of parents and children is most strongly associated among black women and white men (Table 2). In fact, it appears that these two groups are driving much of the correlation shown in the gender-specific or overall results.

It is possible that these results are related to greater variation in fertility outcomes among these four sex and race groups. However, the standard deviation of CEB is similar across all groups. The standard deviation of the number of grandchildren is also roughly equal, with the exception of white women, whose standard deviation is one grandchild less than the other three groups. We therefore dismiss differences in variation among groups as an important driver of the results shown here.

When the role of birth order is considered, some patterns emerge. The association between the fertility of mothers and children strengthens with family size for black families, as does the difference between the fertility of firstborn and later born siblings (Figures 1 and 2). In white families, children from moderately sized families have higher average fertility than those raised in small or large families. In addition, the firstborn effect is smaller than in black families, and non-existent in the case of white females. The interpretation of this result is unclear.

Although the moving average-like relative measures account for changing levels of fertility over time, they do not explicitly consider the role of time. If we break the data into two groups, we can examine intergenerational fertility correlations in the time before and after the period of oil migration. Those born before 1900 entered their childbearing years before the oil boom, while those born after the turn of the century reached childbearing age after oil was discovered. The results of this comparison, not shown here, indicate that the strength of intergenerational fertility correlations increases after the discovery of oil. This supports the common finding that fertility correlations between generations tend to strengthen over time (Murphy, 1999). However, the relative positioning of the four sex- and race-based groups remains the same both pre- and post-oil, even though the correlations during the pre-oil period are not statistically significant.

In a multivariate context, mother's cohort relative CEB is predictive of children's relative CEB after controlling for race, sex, year of birth, and whether firstborn and including sibling random effects (Table 3). The coefficient for the intergenerational component is small, but significant ($\beta_{\text{Mother's CEB}}$=0.063, *p=.002*), after controlling for index individuals' characteristics and family random effects. This finding suggests that the random effects model, in part, accounts for family-level factors that may be inflating the simple bivariate estimates of intergenerational association in relative CEB, but that the relationship, although small, is robust to these controls.

Cox proportional hazard models of time to first birth

For the combined model and each sex and race category, several intergenerational variables are significantly associated with the timing of first births. Results for higher order births are mixed and suffer from decreasing numbers of observations, and therefore power, so they are not presented here. Hazard ratios of covariates associated with index individuals and their mothers are shown in Table 4. Hazard ratios with values greater than one indicate a higher hazard of first birth, while ratios less than one indicate a lower hazard of first birth, conditional on family random effects. For the combined model and white and black men, mother's relative number of children ever born is positively and significantly related to the hazard of first birth. The hazard ratio associated with mother's CEB is highest for black men (1.28), followed by white men (1.17). For black women, the hazard ratio approaches statistical significance (1.12, p=.086). The effect of mother's fertility is smallest and not significant for white women (1.097). Thus, all else being equal, black men whose mothers have one child more than their cohort average had a 28 percent higher hazard of producing a first child than those whose mothers' fertility match their cohort average number of children ever born, after accounting for within-family correlation.

Other measures of the relative fertility of mothers yield mixed results by sex and race. When the coefficients were significant, children whose mothers have a higher than average age at first birth experienced a higher hazard of first birth, while those with a later age at last birth are at a lower risk of experiencing a first birth. Individuals whose mothers have higher intensity childbearing careers, which can be interpreted as short inter-birth intervals or a higher rate of childbearing, experience a higher hazard of first birth.

The effects of the vital status of the index person's mother and father vary by sex. White men with deceased mothers are less likely to have a first child and black men with deceased fathers are also at a lower risk of fathering a child. Parent's vital status does not have a significant effect on the timing of first birth for all women. The marital status of the index person's mother is also included in the models. This variable may account for differing family-formation practices. For white men and women, the hazard of first birth decreases if their mother had ever been married. For black men and women, there is no significant effect of mother's marital status.

Covariates associated with index individuals are also significant. The timing of marriage is a significantly increases of the hazard of first birth within all groups. An individual's place within their sibling set approaches significance for black women (*p*=.057). For these women, the eldest born experience a higher hazard of first birth relative to their later-born siblings. If a dummy variable for pre- or post-oil birth cohort is substituted for the year of birth, the pattern of findings remains the same. The oil-related dummy variable is only significant

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among white men, who experience lower hazards of first birth during the pre-oil period. This finding supports the idea that white men, who participated in seafaring work before the discovery of oil, were away from the island for extended periods and therefore experienced a lower risk of fathering children. In the race and sex-specific models, theta, the estimated variance of family random effects, is significant, indicating that there is significant within-family correlation.

Discussion

There are sex and race differences in the association of fertility measures between generations. This finding alone is not surprising, given that reproductive behavior in Saba is tied to several processes and factors, including labor migration, economic opportunity, and family formation, which vary by race and sex. However, the pattern we observe among the four race and sex groups requires explanation. Suppose that hypotheses that connect the increasing ability to realize fertility preferences with the increase in intergenerational correlations in fertility during the demographic transition can be extended to intergenerational fertility patterns in contexts other than the demographic transition. In this expanded view, we would expect that the correlation between the fertility of parents and their children is strongest in contexts where individuals have the resources and ability to attain their desired fertility and lower in contexts that place constraints on fertility behavior in form of strong expectations about the proper context, timing, tempo, or quantity of fertility. Finally, suppose that this expectation extends to subpopulations that are differentially able to achieve their fertility preferences. Social standing on Saba is largely determined by socioeconomic status, education, gender, and race, so these factors may be related to intergenerational patterns in fertility, as people would have differential access or ability to reach their desired goals, whether it involves entry into a marital union or reaching a target number of children. The economic opportunities presented by off-island migration also vary by race and gender.

We expect that white men, who are the most socially privileged, are better able to attain their fertility goals, while white women, who face an unfavorable marriage market and limited economic opportunities outside of the home, are less able to realize their fertility preferences. For instance, the high instance of permanent celibacy among white women is one indication of the constraints placed on their fertility. The expected patterns for black men and women are less clear. Black men faced more challenges in obtaining off-island work than their white counterparts. Black women, in contrast, had greater economic opportunities than white women did, as they could leave the island to seek work or work locally outside of the confines of their homes. They also had greater flexibility in family formation strategies, as they were not faced with the same strong expectations of exclusively marital fertility that constrained the fertility behavior of white women. In addition, it has been argued that non-marital family forms within the black community were, to a certain extent, transmitted across generations (A. E. Sullivan, 2006). If this is the case, the intergenerational transmission of family formation practices may strengthen the association of other fertility behaviors among blacks. We expect therefore, that the strength of intergenerational ties in fertility patterns for black men and women will fall somewhere between white men, who are presented with the most options, both socially and economically, and white women, who experienced the most limited set of choices with respect to factors that could influence fertility behavior.

The results of the bivariate correlations and event-history models presented here are consistent with the view that intergenerational fertility associations are strongest among groups that have a greater ability to realize fertility preferences. For every measure of fertility, including those broken down by sibling status, white women have no statistically significant bivariate correlations with the fertility of their mothers. In the event-history models of the timing to first births the only statistically significant intergenerational finding is that white women whose mothers had married have a lower hazard of first birth. This may indicate that the expectation of martial fertility was transmitted between the generations, thereby delaying entry into childbearing for those women whose mothers set the example of childbearing within marriage. This result was also found in the case of white men, who also had a lower hazard of childbearing if their mothers had been married, further bolstering the case for the intergenerational transmission of the expectation of marital fertility in white families.

In contrast to white women, white men had the greatest number of statistically significant correlations with the fertility of their mothers. In addition, the magnitudes of these correlations were usually among the highest. This finding is consistent with their status as the most privileged group in Saban society, both in social and economic terms as well as in light of the marriage market. From this position of advantage, white men could attain their fertility goals and realize preferences that may have an intergenerational component. An interesting finding from the event-history models concerns the vital status of the mothers of these men. White men whose mothers had died experienced a lower hazard of first birth. Perhaps the death of a mother changed the economic or migration behavior of these men in ways that decreased their fertility.

Given our hypothesis about the interplay of race and gender in the realization of fertility preferences, black men and women were predicted to have intergenerational fertility that was intermediate to the higher expected levels of white men and lower expected levels of white women. The results of these analyses support this idea. In particular, the social and economic realities of black women gave them greater flexibility in fertility-related behavior than white women. In the bivariate correlations of fertility measures, black women fall just behind white men in the number and magnitude of significant fertility correlations. Black men have fewer statistically significant bivariate correlations than black women do, but the hazard ratio associated with mother's relative number of children ever born is the largest of all four groups.

Unfortunately, the Saba genealogical database does not contain information about several potentially important predictors. There is limited individual-level information on socioeconomic status, health, education, and the propensity to migrate. These factors may all be related to the intergenerational transmission of fertility behavior. This may contribute to biases in the results reported here. While we have taken steps to attempt to account for some of these potential biases, such as limiting the sample to those who survived their reproductive years and including family-level random effects in the multivariate models, it is not possible to ascertain the extent of any remaining bias. However, several intergenerational predictors remain significant in the multivariate models with family random effects. If some of these potentially biasing traits, such as health and socioeconomic status are correlated within families, these models will partially account for their effects. Thus, our analysis does suggest that the reported intergenerational associations in fertility are not solely artifacts of data selection or unobserved heterogeneity.

The intergenerational transmission of fertility behavior is present in the racially heterogeneous and highly mobile population of Saba. However, the strength of intergenerational patterns in reproductive behavior varies along racial and gender lines. Groups that have greater opportunity to realize their fertility preferences have stronger associations with the fertility of their mothers, while those with the most limited prospects for reproduction have the weakest associations. These findings are relevant for research on the determinants of fertility in racially diverse populations or populations that participate in labor migration and out-migration.

The demographic transition marks a shift in the influence of the fertility of one generation on the fertility of the next, which may be explained in part by the increasing ability of individuals to act on the goals and preferences that were at least partially shaped by their parents. While this study has focused on social and economic explanations for variation in the strength of intergenerational associations in fertility, it does not necessarily contradict the findings of biological studies of fertility. Indeed, as Udry (1996) notes, biological factors are more likely to influence behavior when choice is broad, but in complex societies, some people have more (or different) choices than others. Such heterogeneity increases the potential for interaction between biological and socio-economic factors. We cannot here partition the contributions of biological and socio-economic influences on intergenerational transmission, but we do argue that not all individuals in Saba may have been equally able to attain their desired fertility. Therefore, when studying intergenerational patterns of fertility in post-transitional populations it is also important to consider within-population variation in ability to make choices and achieve fertility preferences both on their own and in possible interaction with biological influences.

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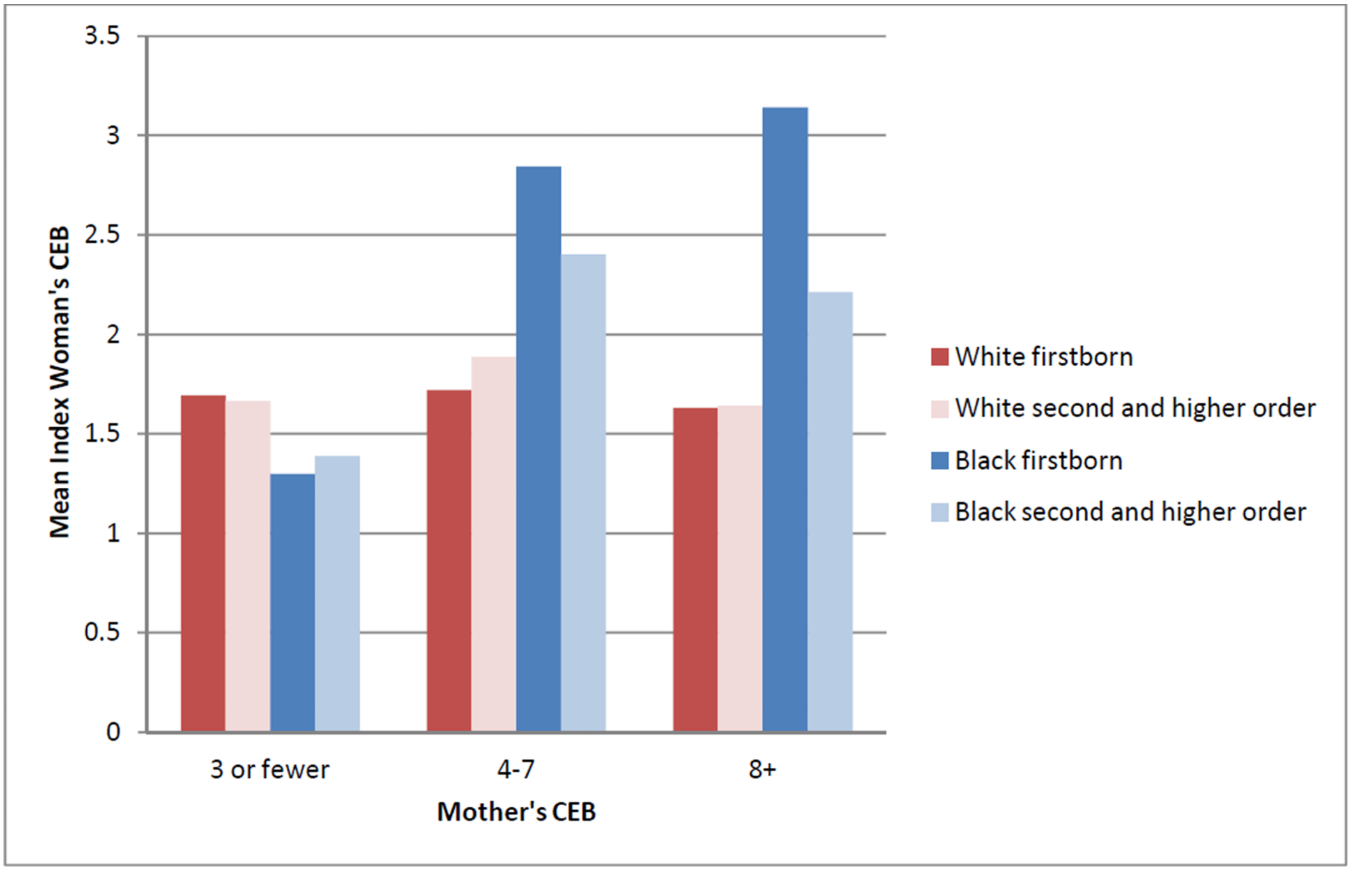

Figure 1.
Women's average number of children ever born by mother's number of children ever born.

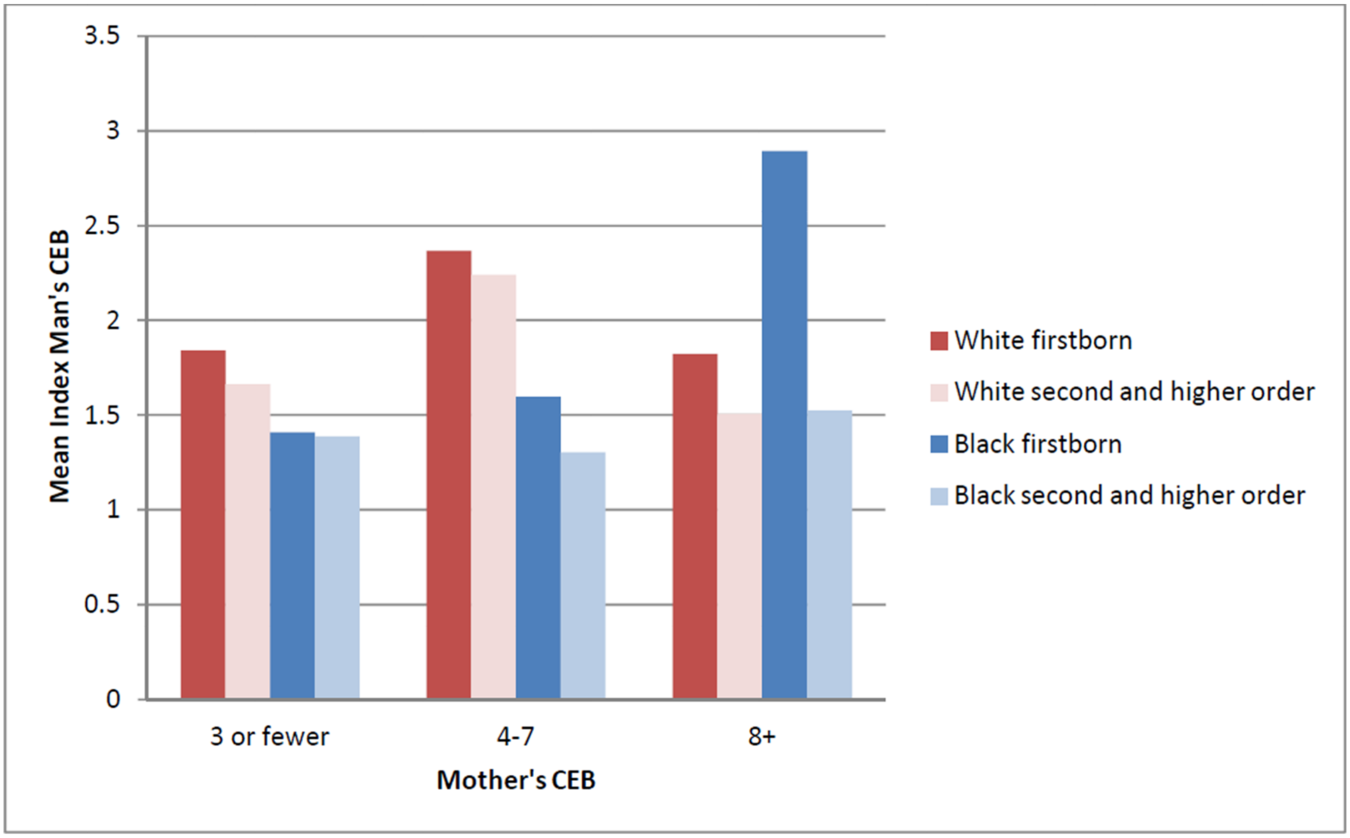

Figure 2.
Men's average number of children ever born by mother's number of children ever born.

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Table 1

Pearson product-moment correlation coefficients of cohort-relative fertility measures for men and women.

Women			
	Coef	***p*-value**	**N**
Age at First Birth	0.026	0.495	717
Age at Last Birth	0.054	0.159	693
Age at Marriage	0.030	0.615	292
Span of Childbearing Years	−0.003	0.945	675
Intensity of Childbearing	−0.036	0.346	675
Children ever Born	0.084	0.001	1628
Men			
	Coef	*p*-value	N
Age at First Birth	0.070	0.099	551
Age at Last Birth	0.085	0.050	533
Age at Marriage	−0.086	0.171	257
Span of Childbearing Years	0.079	0.076	514
Intensity of Childbearing	−0.018	0.689	514
Children ever Born	0.081	0.001	1603

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Table 2

Pearson correlation coefficients of cohort-relative fertility measures by sex and race.

White Women				*White Men*			
	Coef	***p*-value**	**N**		**Coef**	***p*-value**	**N**
Age at First Birth	0.010	0.859	346	Age at First Birth	0.097	0.087	313
Age at Last Birth	0.035	0.526	336	Age at Last Birth	0.028	0.625	301
Age at Marriage	0.042	0.565	194	Age at Marriage	−0.223	0.005	158
Span of Childbearing Years	−0.065	0.239	329	Span of Childbearing Years	0.049	0.404	294
Intensity of Childbearing	−0.042	0.451	329	Intensity of Childbearing	0.014	0.815	294
Children ever Born	0.014	0.694	768	Children ever Born	0.113	0.002	739
Black Women				*Black Men*			
	Coef	*p*-value	N		Coef	*p*-value	N
Age at First Birth	0.014	0.816	262	Age at First Birth	0.036	0.657	155
Age at Last Birth	0.109	0.085	250	Age at Last Birth	0.074	0.362	152
Age at Marriage	−0.010	0.932	76	Age at Marriage	0.056	0.629	76
Span of Childbearing Years	0.091	0.158	242	Span of Childbearing Years	0.010	0.909	141
Intensity of Childbearing	−0.023	0.728	242	Intensity of Childbearing	−0.151	0.073	141
Children ever Born	0.102	0.012	610	Children ever Born	0.045	0.266	611

Table 3

Generalized linear model of index individual's cohort-relative children ever born with sibling random effects.

	Coef.	*p*-value
Mother's relative CEB	0.0632	0.002
Black male	0.1437	0.376
Black female	0.5264	0.001
White male	0.3053	0.024
White female	*ref.*	
Oldest child	0.1128	0.350
Year of birth	−0.0028	0.185
Constant	5.0553	0.203
Sigma group	0.9327	
Sigma error	2.5326	
Rho	0.1194	
Theta (median)	0.1569	

Table 4

Results of Cox proportional hazard models of first birth with sibling random effects. Parental characteristics are all cohort-relative measures of mother's fertility, unless otherwise noted.

	Combined		***White Women***		***White men***		***Black Women***		***Black men***	
	Hazard Ratio	**p-value**	**Hazard Ratio**	**p-value**	**Hazard Ratio**	**p-value**	**Hazard Ratio**	**p-value**	**Hazard Ratio**	**p-value**
Parental Characteristics										
Relative CEB	1.1797	<0.001	1.0972	0.264	1.1747	0.037	1.1168	0.086	1.2847	0.008
Relative Age at First Birth	1.0421	0.037	1.0343	0.403	1.0350	0.355	0.9985	0.967	1.1068	0.057
Relative Age at Last Birth	0.9431	0.003	0.9638	0.363	0.9428	0.117	0.9799	0.570	0.8883	0.025
Relative intensity of Childbearing	1.2606	0.001	1.1484	0.313	1.1056	0.451	1.2478	0.079	1.5208	0.016
Mother's Vital Status (1=dead)	0.7567	0.063	1.4899	0.217	0.5095	0.010	0.6811	0.269	0.9468	0.904
Father's Vital Status (1=dead)	0.7779	0.025	0.7933	0.278	0.9369	0.745	0.9405	0.808	0.5060	0.045
Mother Ever Married (1=yes)	0.6536	<0.001	0.5039	0.006	0.4002	<0.001	0.8607	0.377	1.0017	0.995
Index Person's Characteristics										
Married (1=yes)	1.4789	<0.001	1.5644	<0.001	1.5822	<0.001	1.4359	<0.001	1.6178	<0.001
Oldest Child	1.1915	0.036	0.9631	0.822	1.1257	0.499	1.3103	0.113	1.5747	0.057
Age	1.0575	<0.001	0.9789	0.435	0.9998	0.995	1.0909	0.006	1.0482	0.114
Year of Birth	0.9965	0.029	0.9982	0.653	0.9983	0.657	0.9985	0.636	0.9937	0.131
θ	0.4168	0.061	0.8711	<0.001	0.5760	<0.001	0.3903	<0.001	0.8495	<0.001