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Kinequality in the United States 1910-2009: Race differences in kin availability and familial life course expectations

Pil H. Chung
Departments of Demography and Sociology, University of California at Berkeley

Abstract

Historical differences in the fertility and mortality experiences of black and white Americans have lead to persistent race differences in the availability of kin and expectations on the ages of transition into and out of different kin relations. Taken together, these differences represent a demographically-driven form of familial life course inequality that I term *kinequality*. Using microsimulation techniques to generate complete genealogical data, I calculate plausible estimates of kinequality between the black and white U.S. national populations over the period 1910 to 2009 with particular attention paid to the pre-adult ages. Results suggest that black Americans are likely to have transitioned into kin relations at earlier ages and to have spent fewer years in those relations. For kinship transitions initiated by the death of one or more family members (e.g., orphanhood), black Americans have been in a much more vulnerable position: They experience familial death more frequently and at earlier ages than their white peers. With the important exception of orphanhood, these kinequality patterns have become less pronounced over successive birth cohorts, suggesting slow, but growing convergence of familial life course experiences of black and white Americans over time.

Introduction

The death of a family member is often a significant disruption in the life trajectories of those experiencing the loss. This is especially true during childhood and adolescence, when close family members, parental figures in particular, serve as a primary source of emotional and material support (Hogan and Astone 1986; Umberson, Crosnoe, and Reczek 2010). In addition, the death of a loved one at an early age likely presents affected youth with a set of existential challenges that may lead to altered life expectations and behaviors (Brown and Harris 1978; Finkelstein 1988; Wickrama et al. 2008). In such ways, early-life exposure to death in the family may trigger important changes in the emotional, material, and behavioral wellbeing of adolescents.

To the extent that the likelihood of childhood exposure to death in the family is conditioned by race differences in patterns of fertility and mortality, we might think of differences in childhood exposure to death to be an important source and manifestation of ongoing racial inequalities. This particular form of demographically-mediated racial inequality operates along two dimensions: a) differences in kin availability, and b) differences in familial life course expectations. The former indicates inequalities in the network support opportunities afforded by living kin, while the latter indicates inequalities in the timing and sequence of transitions into and out-of different familial relations initiated by the birth and death of kin.

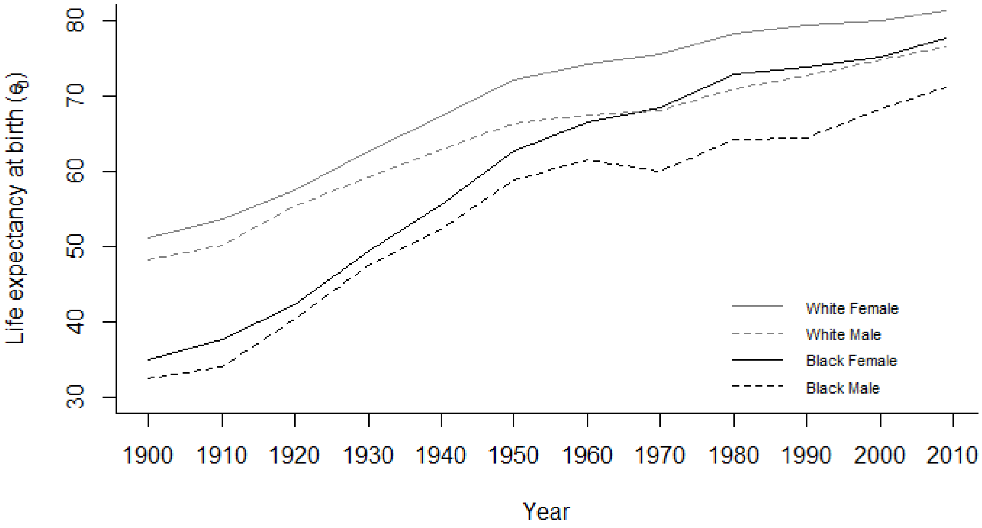
In this paper, I use the term *kinequality* to denote the combination of these two factors, which together produce qualitatively distinct developmental environments: at one extreme, childhoods characterized by late and infrequent exposure to death in the family and a consequent abundance in familial support opportunities; and at the other extreme, childhoods characterized by early and frequent exposure to death in the family and a subsequent dearth of familial support opportunities.

It is the goal of the present paper to estimate and characterize the kinequality that existed between black and white populations in the United States at different moments in history. To do this, I rely on microsimulation techniques to generate complete kinship data for the black and white national populations calibrated to match the demographic behaviors observed in these populations over the period 1910 to 2009. Using these data, I estimate the race-specific probabilities of transition into and out of different kin relations at each age for birth cohorts that correspond to today’s youth, working-age adults, and seniors.

Background

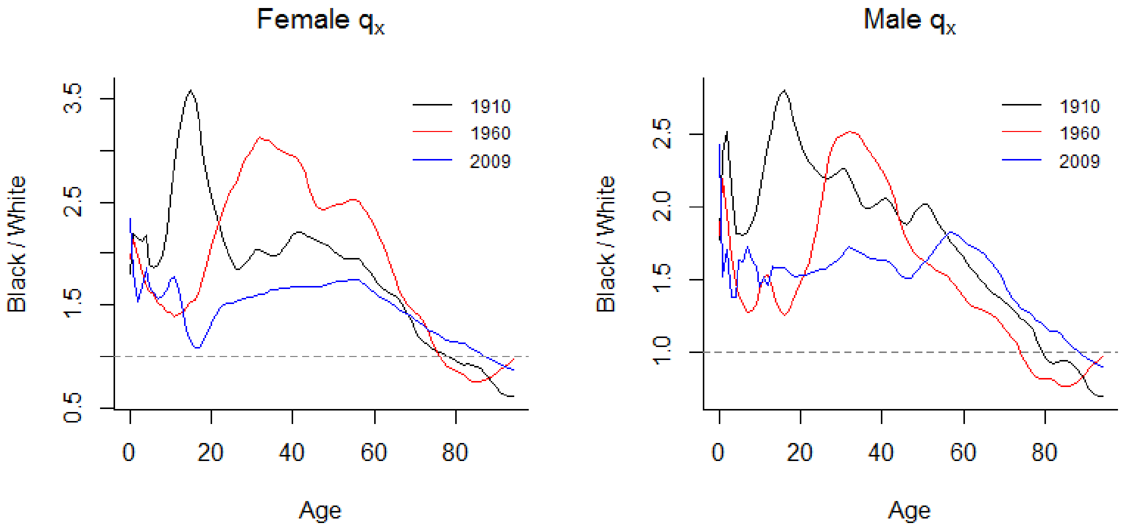
Differences in the mortality experiences of black and white populations in the United States have been well characterized. In general the cross-sectional pattern of all-cause mortality has been one of long-run convergence (Figure 1). However this convergence has been slow and imperfect; and race gaps in particular age-specific mortality rates persist (Arias 2014; Murphy, Xu, and Kochanek 2013; Sloan et al. 2010).

Figure 1. Life expectancy at birth (e_0) over time by race and sex (Data: NVSS Life Tables)



In particular, the infant mortality risk of black Americans continues to be markedly higher than that of white Americans (up to 2.5 times in 2000, and never lower than 1.4 times across all previous and subsequent years). At later ages the pattern flips (the so-called “mortality crossover”) such that by age 90, surviving white Americans face higher risk of mortality than black Americans (Arias 2014; Johnson 2000; Lynch, Brown, and Harmsen 2003).[1] In fact, the patterns of age-specific mortality for black and white populations in the United States have never reached parity. Throughout the 20th century and well on into the first decade of the 21st, mortality risk at nearly every age has differed significantly by race (Figure 2).

Figure 2. Ratio (black/white) of death probability (q_x) at each age for select years (Data: NVSS Life Tables)



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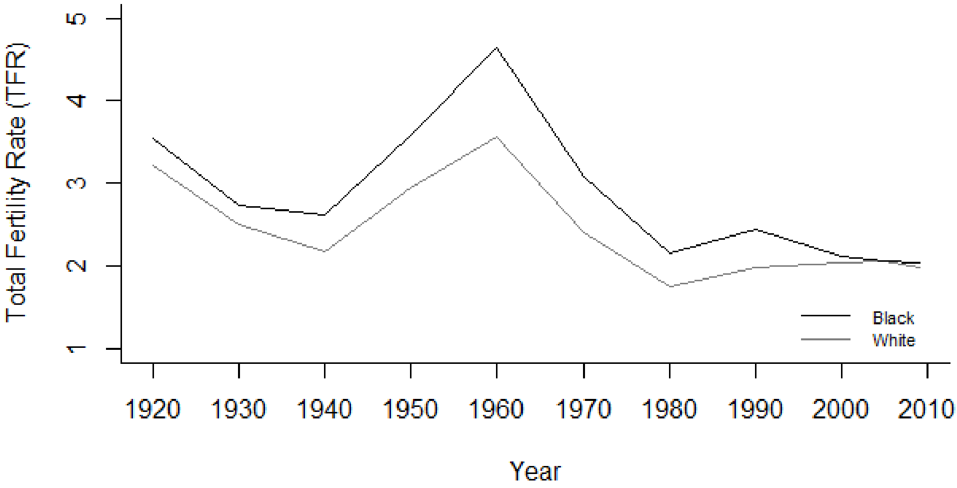
[1] More recent research (Masters 2012) suggests that the “mortality cross-over” might simply be an artifact of cohort-mixing within each period of observation. That is to say, within the same birth cohort, there may be NO crossover, but rather a continuation of the usual pattern of higher mortality risk for blacks relative to whites even at the oldest ages.

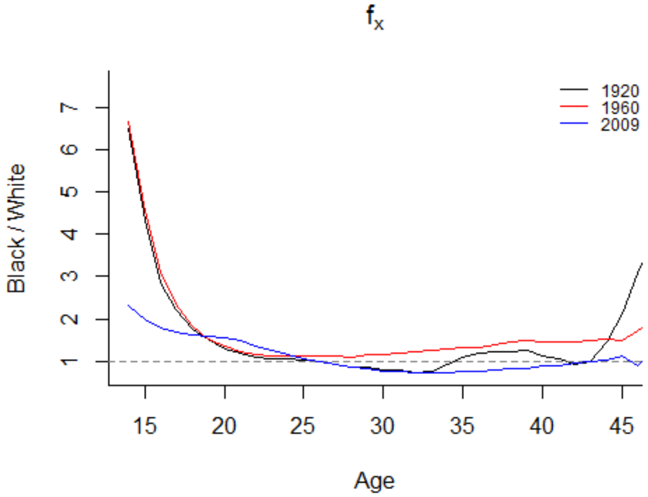
Black-white differences in cross-sectional fertility patterns, on the other hand, have not been quite as dramatic. The total fertility rate (approximately: the average number of children per woman) of the black population has remained consistently higher than that of the white population (by about half a child) for most of the past century (Figure 3). This difference has diminished in recent years (Hamilton and Cosgrove 2010, 2012; Heuser 1976).

Figure 3. Total fertility rate (TFR) over time by race (Data: NCHS Central Fertility Rates)



Despite the recent convergence in total fertility rate, there remain marked race differences in the age-specific patterns of fertility observed in even the most recent periods. Notably, the rate of teenage child-bearing is higher for black Americans than that of white Americans (1.72 times on average for 14-18 year-olds in 2009, and nearly twice that in decades past). However, the rate of childbearing in the remaining reproductive ages is more similar between the black and white national populations (Figure 4).

Figure 4. Ratio (black/white) of fertility probability (f_x) at each age for select years (Data: NCHS Central Fertility Rates)



The persistence of these trends has motivated much research highlighting inequalities in the mortality and fertility experiences of black and white Americans. However, this research has often remained narrow in scope, dealing with inequalities as manifest only at distinct moments within the life course. Studies often focus on discrete segments of the age-specific mortality and fertility profiles of blacks and whites, and on only those causal explanations that account for the majority of deaths and births in those particular age categories.

For example, studies examining the race gap in infant mortality typically restrict analyses to the earliest ages (< 1 year) and frame discussions mainly in terms of complications due to low birth weight (e.g., Carmichael and Iyasu 1998; Iyasu and Tomashek 2002; Schempf et al. 2007; Schoendorf et al. 1992). Studies examining the race gap in adolescent and young adult mortality risk typically restrict analyses to ages below 24 and frame discussions mainly in terms of "external causes" (i.e. suicide, homicide, and accidents) (e.g., Mulye et al. 2009; Singh and Yu 1996). Studies examining the race gap in the remaining adult years typically frame discussions in terms of socio-economic resources, healthcare access, chronic disease, and frailty (e.g., Davey Smith et al. 1998; Hummer 1996; Johnson 2000; Macinko and Elo 2009; Rogers 1992; Sorlie et al. 1992)

Research on the race gap in black-white fertility, too, is often conducted separately for specific age categories. For example, fertility differences at younger ages are often considered within the context of pre-marital childbearing, focusing on causal factors embedded in the childhood developmental environment (e.g., Bumpass and McLanahan 1989; South and Baumer 2000). Fertility at later ages, meanwhile, is often considered within the context of marital fertility, and research focuses on causal factors related to adult mate availability, socio-economic situation, and fecundity (e.g., Jain 2006; Smith, Morgan, and Koropeckyj-Cox 1996; South and Lloyd 1992; Wellons et al. 2008).

What receives far less attention in the literature on black-white demographic differences is the ongoing impact of fertility and mortality events at one moment in the life course on subsequent life course moments; or more precisely: the impact of these race gaps on the life course trajectories of the surviving families and future generations. Thus, what is often missing from the literature on black-white mortality and fertility gaps is a "big picture" of race differences in familial co-existence over the life course and the concomitant implications for early or delayed transitions into different familial roles for black and white family members. For example, research has documented the scale and causes of race differences in infant mortality, but we have little sense of how this mortality difference translates into differences in (for instance) the experience of siblinghood and grandparenthood between black and white families.

At first glance, the historical convergence of overall mortality and fertility trends in the black and white national populations might seem to suggest that race differences in family networks will naturally fade over time. However, this is not at all certain. Though black and white life expectancies and total fertility rates have indeed been growing more similar over time, persistent race differences in the way that fertility and mortality events are distributed over age may lead to meaningfully divergent trajectories of family life course experience. For example, black women and white women may have the same number of children over the course of their lives, but consistently later childbirth by the latter group results in later transitions to motherhood and subsequently higher likelihoods of maternal orphanhood at earlier ages (holding all else constant). In such ways, persistent race gaps in fertility and mortality at specific ages may not necessarily shift the overall *levels* of kinship, but they may very well change its *distribution* over a life time.

Thus, the demographic history of a family is not only reflected in the births and deaths of a single historical moment, but in the accumulation of several such moments embedded in the living memories of individuals and their kin, spanning over multiple generations. This complex interplay between the life trajectories of individuals and their kin makes characterizing the likely configuration of the family neither a simple nor predictable task. In the following sections, I introduce a theoretical framework founded on a demographic understanding of kinship and an analytic strategy based in simulation that enables us to begin this delicate task of discovering family in the intricate web of individual life lines.

A demography of kinship

Demography provides a ready analytic apparatus for measuring intergenerational effects of black-white mortality and fertility differences over historical time and throughout the lives of individuals related by familial ties. If the boundaries of family are conditioned by the genealogical fact of kinship, then examining the fertility and mortality trends of populations can help identify the likelihood of being in any particular kinship relation at any given point in time for individuals within those populations. For example, if parenthood is defined simply as the co-existence of a biologically-related child, then the average likelihood of being a parent is adequately approximated by the age-specific rates at which individuals in the population reproduce and die.

Thus, demographically-demarcated kinship relations allow for an analytically tractable exploration of kin availability, and by extension, the opportunity for family. This insight has been a powerful driver of foundational research in the demography of the American family. For example, Uhlenberg (1980) used observed U.S. fertility and mortality rates in 1900, 1940, and 1978 together with assumptions regarding the average age of parents to predict shrinking probabilities of orphanhood, death of close family members, marital dissolution due to death, and longer durations spent in widowhood (Uhlenberg 1980). Similarly, Watkins and colleagues (1987) used a series of multi-state projection matrices in conjunction with observed U.S. fertility, mortality, and marital rates to estimate the proportions of individuals "surviving" in different familial relations over the period 1800 to 1980. This research demonstrated how, despite declining rates of childbearing and increasing rates of divorce, women born in the latter half of the 20th century spent more time as parents and in marriages than did women in previous generations (Watkins, Menken, and Bongaarts 1987).

Recently, improvements in computational power have allowed for more sophisticated simulation techniques that enable the modeling of demographic behaviors at the individual level. These techniques generate kinship projections at finer resolutions, and often with great fidelity to empirical fact (Wachter, Blackwell, and Hammel 1997). For instance, a study by Murphy (2011) used this type of microsimulation to characterize the transformation of kinship networks in England and Wales over the period 1850 to 2010 (Murphy 2011). Using rates of fertility, mortality, and partnering derived from multiple historical sources, Murphy (2011) produced the first plausible estimates of kin availability in these regions over the course of their demographic transitions.[2] These estimates suggest that, over time, the mean number of older generation kin (e.g. grandparents) rose on average, while the mean number of kin of similar or younger generations (e.g. siblings and children) declined.

The present study extends this line of inquiry by examining the role of *race* in demarcating important differences in kinship patterns over individual and historical time in the United States.

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[2] The "demographic transition" is the movement of a population from a regime characterized by high fertility and high mortality to one characterized by low fertility and low mortality (for extended discussions see: Caldwell 1976, 2004).

Black-white differences in family structure

Several studies examine black and white American kinship networks in specific regions, at specific times, or for specific familial relations (e.g. Agresti 1978; Eggebeen and Uhlenberg 1985; Eggebeen 2002; Morgan et al. 1993), but there are few comprehensive examinations of black and white kinship networks at the national level and over wide stretches of historical time for a wide range of kinship relations. A notable exception is a study by Ruggles (1994) that uses data from the Integrated Public Use Microdata Series (IPUMS) to characterize the compositions of familial households of black and white Americans over the period 1880 to 1980 (Ruggles 1994). This study finds that single-parent families and extended families (i.e., families containing kin other than children and spouse) are found to be more common among black American households than among white American households. This trend was present throughout the period 1880-1980, and there is evidence that the race gap in familial household composition has in fact *increased* over that same period (Ruggles 1994).

The analysis presented in Ruggles (1994) represents the first time that historical census records have been fully leveraged to characterize compositional differences in nationally-representative samples of black and white American families over time. In some respects, this study provides the most comprehensive answer to the question of how black and white Americans are likely to have experienced family differently throughout most of U.S. history: black individuals are more likely than their white peers to have had absent parents, absent spouses, and distant relatives in close physical proximity.

One important limitation of Ruggles (1994) is related to its reliance on household-level data. The assumed relationship between households and families is given in a footnote: “Following U.S. Census Bureau practice, the term family refers here to any group of related people who reside together” (p.139). In other words, family networks are captured only to the extent that their relational linkages fall within the boundaries of the household. This leads to imperfect estimates of family configuration since the moment a family member leaves the household for any reason (e.g., to go to college, to work-stay in another country, etc.) they are lost to observation. Additionally, certain non-nuclear kin (e.g., adult siblings, nieces, nephews, etc.) are likely to be missed altogether since these individuals are frequently non-co-resident in many U.S. contexts. Finally, data derived from the U.S. census only allows for period-specific estimates; within-household changes in family configuration are not reliably tracked over time.

The present study seeks to address these limitations by using microsimulation techniques (calibrated to U.S. Census inputs) to produce complete kinship data un-constrained by household boundaries, and measurable at any moment in time. In this way, this study is both an extension and an alternative approach to the research started by Ruggles (1994). Like Ruggles (1994), this work lends particular attention to family configurations that are likely to be disadvantageous to youth; but it conducts this investigation taking complete individual genealogical histories rather than familial households as its unit of analysis.

The microsimulation paradigm

As noted in the previous section, microsimulation provides many advantages as a demographic projection technique. Foremost is the ability to generate complete individual-level data from aggregate-level inputs. With mean age-specific rates of fertility and mortality, it is possible to re-create complete genealogical records for each simulated individual, thus allowing for construction of full kinship networks at any moment in each simulated individual’s life time. While similar results could potentially be obtained via analytic methods (e.g., deriving proportions in different kinship states using stable population equations and multi-state life tables), these techniques become intractably complex as the number of possible simultaneous kin relations expands to include a wider range of possible relational combinations (e.g., estimating proportions of last children with no living uncles).

Microsimulation also has limitations, which sort into two broad categories: “mechanical” and “semiotic.”

Mechanical limitations refer to deficiencies in the programming of the simulation algorithms that lead to estimates that diverge significantly from observed truth. The most serious limitation of this kind is the inability of traditional microsimulation to account for within-family correlations of demographic behaviors, including the “inheritance” of fertility between mothers and daughters. This leads to unrealistic simulated distributions of kin per individual by reducing population-level heterogeneity in family size (Ruggles 1993).

Semiotic limitations refer to the inability of the simulation to model individual behavioral patterns not programmed in advance. Succinctly: simulated data are not “real” in the sense that they are not derived from measurements on real individuals. Therefore, such data are devoid of meaningful variation due to un-accounted for socio-cultural processes. Instead, idiosyncrasies in individual behavior observed within the simulation are deliberately introduced or just random variation.

In the present study, what is indicated by this latter limitation is that simulated kinship data are not identical to family data. The genealogical fact of “kin” (a function of purely biological relations), though closely related, should not be seen as exactly equivalent to the experience of “family” (a complex system of biological and symbolic affinities). Mechanical limitations of microsimulation are readily resolved by careful programming, but the semiotic limitations are insurmountable and must be acknowledged as a *necessary* limitation under which we conduct analyses and interpret results.

Kinequality

So far, I have discussed how differences in the kinship networks of black and white populations can be understood as a function of their differing vital rates. These differences also imply consequences for the relative wellbeing of these populations. The following sections discuss two mechanisms through which differences in kinship may impact wellbeing: *kin availability* and *familial life course expectations*. Taken together, these mechanisms encompass *kinequality*.

i. Kin Availability

One plausible mechanism by which race differences in kinship patterns may lead to meaningful differences in the life chances of black and white Americans is by differentially constraining the opportunity for *social support*. Understood as a bundle of instrumental and emotional resources (or deficits) made available by virtue of some set of relational ties, social support (or its lack) has been posited as an important source of advantage and disadvantage for individuals at all moments within the life course (Umberson et al. 2010). A substantial literature on the “transition to adulthood” describes the many ways in which the navigation of relational and institutional ties in pre-adult years are critical to future wellbeing (Hogan and Astone 1986; Shanahan 2000).

The family, as a primary site for early-life support and socialization, takes a central location within this framework (Steinberg and Morris 2001). To the extent that racial subpopulations differ with respect to their family structures during their pre-adult years, differences in the timing and quality of subsequent adulthood transitions might serve as an additional vehicle by which racial inequalities are perpetuated.

This theoretical orientation is made further compelling by stark black-white differences in mortality that exist across all ages that are likely to have limited the relative availability of kinship resources (especially parents) for black versus white minors throughout U.S. history.

The goal of the present study is *not* to determine whether differences in kin availability actually do or do not lead to real long-term social support. The sheer volume of debate on the question of whether single parenthood is or is not ultimately disruptive to child development (e.g., see discussions in Barber and Eccles 1992; Biblarz and Gottainer 2000) demonstrates the complex requirements of attempting such an investigation. In fact, previous research has shown that the mere presence of family in the lives of individuals does not ensure social support, and may actually lead to more deficit than gain (Umberson et al. 2010). Additionally, communities with even extreme resource deficits and sparse kinship networks are able to mobilize extended and affective kin to “fill in the gaps” left by dead or absent family members (Stack 1974).

Thus, the measures of kin availability presented in this paper do not imply anything about the quality or even the realized quantity of familial social support; these things are a product of complex social adaptations and negotiations. Rather, kin availability as a component of kinequality highlights persistent inequalities in the boundaries of biological kinship that limit or make necessary such adaptive negotiations.

ii. Familial Life Course Expectations

Another plausible mechanism by which race differences in kinship may lead to meaningful differences between black and white Americans is by altering normative expectations that govern the timing of particular kinship transitions. The term “expectation” is here invoked in both its technical and colloquial usages, signifying both statistical averages as well as psychological feelings of anticipation. In both usages, what is stressed is the importance of *sequence* (rather than availability) of kinship relations over a lifetime. Historically consistent differences in the kinship networks of black and white Americans may lead to different average age trajectories of kinship transitions – trajectories that are then re-inscribed into the collective memories of those populations and passed on to subsequent generations as normative familial life course expectations. In this work, I pay special attention to particularly disruptive life course transitions (e.g., the transition to orphanhood) experienced in pre-adult ages, initiated by the death of kin.

There is substantial evidence that wellbeing in childhood is an important determinant of wellbeing at all subsequent stages of life (Case, Fertig, and Paxson 2005; Haas 2008; Palloni et al. 2009). In this context, the death of a close family member has the potential to be a particularly disruptive experience in youth that can lead to significant consequences to wellbeing throughout the remaining years of life. Indeed, the loss of a parent during childhood and adolescence has been linked to worse depression outcomes in adulthood (Brown and Harris 1978; Finkelstein 1988; Wickrama et al. 2008). The possibility for such psychological mal-adjustment in the face of parental death during childhood signals the importance of timing in determining our ability to adequately cope with potentially disruptive family life course transitions. Whether due to cognitive under-development, lack of relevant behavioral scripts, or the increasing unlikeliness of a given transition, individuals who experience these transitions at earlier ages may be less equipped to cope with them than similar individuals undergoing the same transition at older ages. Writing on the impact of historical demographic changes on family life, Hagestad (1986) gives this sentiment eloquently somber expression:

> *"Recent changes in mortality have made the time of death more predictable and have clarified the meaning of the term 'untimely death.' Today, the death of parents before their children has reached midlife, and the death of their children – at any age – would be assigned that label. Because such events are not expected, they may be more traumatic now than they were in the past, for they catch us in the vulnerability of unpreparedness. They are also likely to be lonely transitions, neither shared nor fully understood by peers."* (Hagestad 1986; p.120)

To the extent that the distribution of such 'untimely' family life course events (e.g., the death of a parent) is conditioned by race differences in mortality, individuals of certain race groups are more frequently forced into situations where their normative life course expectations must be re-evaluated in light of more frequent exposure to previously "unexpected" events. Indeed, the additional psychological burden that this process of re-evaluation demands may well be a contributing factor to the persistence of observed childhood inequalities between black and white populations that eventually lead to race differences in wellbeing in later adulthood (Haas and Rohlfsen 2010).

It should be noted that the possibility of harm due to unexpected life course transitions is simply that: a possibility. There is evidence that children and adolescents are quite resilient in the face of early-life disruption, such that often there are no lasting impacts on adult wellbeing (Steinberg and Morris 2001). The purpose of the present study, therefore, is not to determine whether differences in expected familial life course trajectories do or do not lead to actual differences in wellbeing. Rather, these differences as a component of kinequality are meant to highlight persistent inequalities in the timing and sequence of transitions into different kinship relations that limit or necessitate these possibly stressful psychological and relational re-adjustments. For example, the degree to which black and white Americans differ with regard to when and how frequently they experience the loss of different family members at childhood and adolescence strongly determines inequalities in early-life exposure to bereavement and forced transitions out of familiar kinship relations. These inequalities may alter the internal calculus of affected youth such that future behavior becomes conditioned by perceptions of life course risk and reward that differ strongly by race.

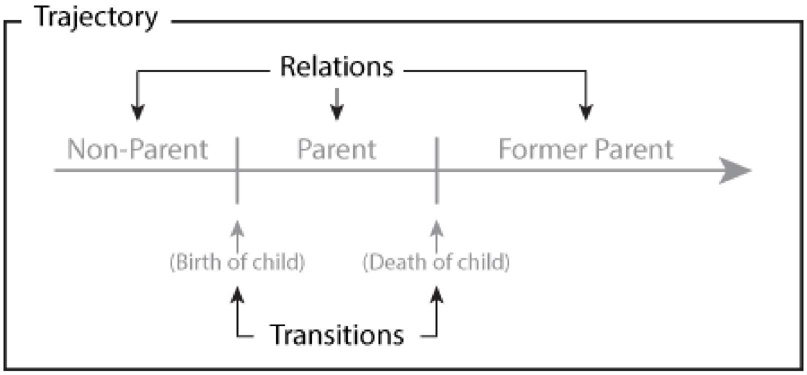
Methods

Operating Definitions

It has been suggested that black-white inequalities in wellbeing might be profitably studied following a careful application of the life course perspective (Colen 2011; Haas and Rohlfsen 2010). Under this perspective, outcomes are conditioned by accumulated advantage and disadvantage over subsequent "stages" of life experienced within particular historical contexts. Operative concepts within the life course paradigm are *transitions* and *trajectories*, where the former denotes qualitative shifts into and out-of new roles and behaviors, and the latter denotes the particular sequences and timings of these shifts (Elder 1985, 1998).

In the present study, I adopt the life course language of "transitions" and "trajectories." To this conceptual repertoire I add the network analytic concept of "relation" as a state defined by a relational linkage or "tie" (Wasserman and Faust 1994). "Transitions" are thus the movements into and out of these "relations" initiated by the breaking and forming of relational ties; and "trajectories" are the temporal sequences of these transitions (Figure 5).

Figure 5. The relationship between “relation,” “transition,” and “trajectory”



With this vocabulary in mind, I operationalize a set of kin relations to analyze by allowing ages at kin birth and death to demarcate the boundary points that mark transitions into and out of different kin relations (Table 1).

Table 1. Operating definitions of kin relations

Relation	Definition
Defined by life of kin	
Grandparent	At least one grandchild alive
Parent	At least one child alive
Sibling	At least one sibling alive
Child	At least one parent alive
Grandchild	At least one grandparent alive
Defined by death of kin	
Former Sibling	All siblings deceased
Former Parent	All children deceased
Single Orphan	One parent deceased
Maternal Orphan	Mother deceased
Paternal Orphan	Father deceased
Double Orphan	Both parents deceased
Grand-Orphan	All grandparents deceased

The Relationship between Kin Availability and Probability of Kinship

The availability of kin and the likelihood of transitions into and out-of kinship relations are directly related. Therefore, to speak of the availability of certain types of kin at certain moments in the life course is to simultaneously speak about the probability of "inhabiting" a given kin relation at that moment. Symbolically this relationship may be written as:

$$\bar{P}_x(r) = \frac{1}{n}\sum k_{ir}$$

where:
$\bar{P}_x(k)$ = mean probability of inhabiting a particular kin relation *r* at age *x*
i = index for an individual in the population of age *x*
n = total number of individuals *i*
k_{ir} = a binary (0/1) indicator that is 1 when kin, *k*, of relation *r* is alive[3] when individual *i* is age *x*.

For example, the probability of a randomly chosen individual of a particular age being a parent is given by the mean availability of children to people of that age in the population. For more complex relations (e.g. "single parent" requiring both the availability of a child and the un-availability of a spouse), the term k_{ir} may simply be expanded to a series of multiplicative terms that each indicate the presence (or absence) of the different required kin.

In the present study, I often present probabilities of kinship as a measure of kin availability. The intuitive relationship between these two concepts described here is what is implied in any discussions that employ both concepts.

Microsimulation with SOCSIM

Data that can be used to directly explore kinship trends are difficult to find. Datasets that include information on kinship networks are often sparse and rarely complete enough to encompass the full range of kin relations held by respondents throughout the course of their lives. To overcome these data limitations, I rely on a microsimulation approach to generate complete kinship data from which to derive estimates of transition rates into and out of kinship relations over time.

The microsimulation is implemented using SOCSIM, a well-validated microsimulation tool,[4] to simulate fictive groups of individuals calibrated to match the demographic behavior of black and white populations over the period 1900 to 2009 (using U.S. Census life tables and central fertility data).[5] Within SOCSIM, these simulated individuals "live" out their digital lifespans: creating offspring and dying within the parameters set by the observed fertility and mortality schedules.[6] At the conclusion of each simulation, SOCSIM returns a complete dataset with the full demographic characteristics of each individual, including all the genealogical variables necessary to reconstruct that individual's entire kinship network.

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[3] Or dead, in the case of relations "defined" by death (see Table 1).

[4] Additional information on SOCSIM may be found in Hammel & Wachter (1976), Wachter (1997), and online at http://lab.demog.berkeley.edu/socsim.

[5] See appendix section 'A1' for a description of the calibration procedure.

[6] To enable simulation of complete lifespans for individuals "born" in more recent decades, vital rates for 2009 (the latest available at the time of this writing) are held fixed at the end of the simulation til the last person "born" in 2009 has passed away.

To facilitate comparisons between black and white experiences, I run two separate batches of these simulations - once with fertility and mortality rates for whites and a second time with the corresponding rates for blacks.[7] Other than the different fertility and mortality inputs, the white American and black American simulations are exactly identical in specification. For the purposes of this analysis, I hold marriage, dissolution, and re-marriage rates constant across races. This choice is made deliberately due to lack of reliable race-stratified, nationally-representative marriage data for the large span of time here examined. The results of these analyses should therefore be interpreted as those black-white differences due to differences in fertility and mortality trends *net* of differences in marital behavior. The main opportunity that is lost by this choice of specification is the ability to account for differences in kinship networks due to divorce and/or re-marriage (i.e., "half" kin relations).

Finally, to reduce variation due to the randomness of any single simulation, I run each race-specific simulation 25 times and average measurements (weighted by sample size) across all runs. As for the "mechanical" limitations of traditional microsimulation (discussed earlier), I remedy those issues by implementing a set of "inheritance" factors that allow for mother-daughter transmission of fertility behaviors.

Analysis

Analysis of the simulated data proceeds in two steps. First, between-race comparisons are conducted for select 10-year birth cohorts: 1940-50, 1980-90, and 2000-2010. These cohorts are chosen to represent individuals who, in 2015, fall between the ages of 65-75, 25-35, and 5-15, respectively. In subsequent discussions, I refer to these groups loosely as the *senior*, *adult*, and *youth* cohorts. Examination of race differences within each of these cohorts allows for the characterization of common features of black-white kinequality. Between-cohort comparisons of race differences in select outcomes characterize the historical trends in black-white kinequality. Considered in sequence, these comparisons provide clues as to whether black-white kinequality is likely to increase or decrease over future generations.

Outcome measures are split into two categories corresponding to each of the two dimensions of kinequality. *Kin availability* is characterized by life-time average age-profiles of time spent in different kin relations defined by the life or death of kin (see Table 1), and age-specific probabilities of transition into and out of these kin relations. *Life course expectations* is characterized by average ages at which deaths of different kin are first experienced, and the age-specific probabilities of experiencing the death of different kin. As discussed in previous sections, special emphasis will be placed on outcomes observed in the pre-adult years.

Results

Kin Availability

Figure 6 presents average durations (in years of age) spent in different kin relations for the "adult" cohort (born in the period 1980-1990).[8] The top panel shows durations for those relations defined by living kin, while the bottom panel shows durations for those relations defined by deceased kin

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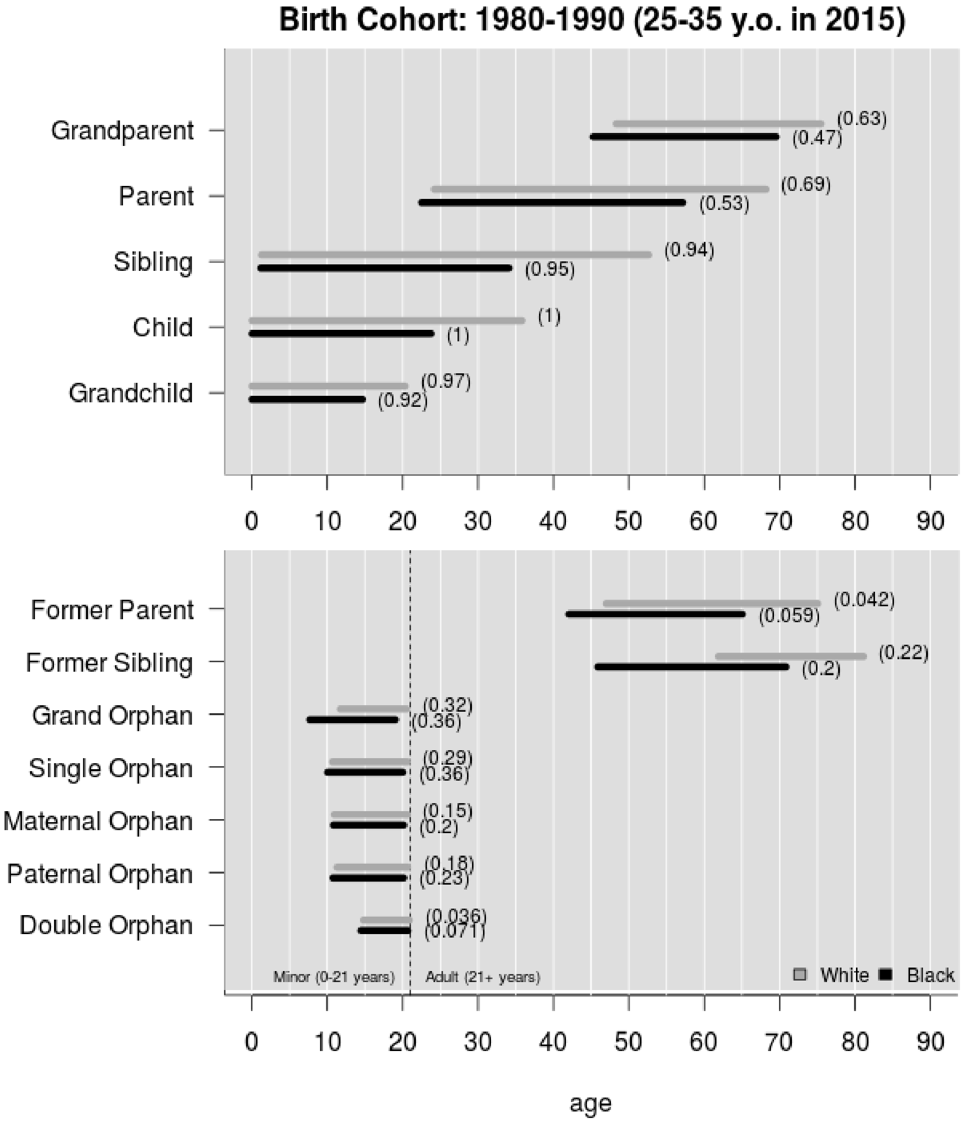
[7] See appendix section 'A2' for a summary table of input parameters.

[8] The general patterns of black-white differences in kinship duration observed in the "adult" cohort are similar to those observed in both the "youth" and "senior" cohorts.

(measurements of orphanhood relations are restricted to the pre-adult years thus capturing pre-adult orphanhood). These age-profiles of average kinship durations are calculated for only those individuals who have ever inhabited the specific kinship relation in question, and so should be interpreted as conditional measurements of kin availability.[9] Lifetime probabilities of ever having made the transition into each of the kinship relations are given in parentheses next to each horizontal duration bar.

Figure 6. Average durations (over age) spent in different kin relations by race for the 1980-1990 birth cohort. The age profiles are contingent on ever having spent time in a given relation. The numbers in parantheses to the right of each horizontal bar gives the proportion of all individuals who have ever spent time in that particular relation. The top panel includes kin relations defined by living kin, while the bottom panel includes kin relations defined by deceased kin.



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[9] Since kinship relations are defined by the existence (or absence) of particular types of kin (see Table 1), statements about time spent in different kin relations naturally implies statements about the likely availability of those kin.

The most notable black-white differences in the age-profiles of relations defined by living kin are earlier average ages of transition into kin relations and shorter durations for black individuals relative to their white counterparts. Additionally, black individuals are less likely to have ever inhabited each of these kin relations over their lifetime (with the exception of childhood, and perhaps siblinghood). Earlier average ages of transition reflect higher fertility of the black population at earlier ages that make different types of kin available sooner. The shorter duration and lower lifetime likelihoods of inhabiting these relations reflect the higher mortality of the black population at earlier ages that make it less likely that individuals live long enough to transition into certain kinship relations and more likely that they transition out of those relations via death.

As for kin relations defined by deceased kin, black individuals transition into each of these relations at earlier ages relative to their white counterparts. However, black individuals also spend more time inhabiting each of these relations (with the exception of former parenthood); and for many of the orphanhood relations they are much more likely to have transitioned into them in the first place. All of these patterns are driven predominantly by the higher rates of mortality at earlier ages for the black population that trigger earlier transitions into these kinship relations.

Figure 6 highlights the general pattern of black-white differences in lifetime kinship probability and duration. These patterns are precisely quantified by differences in average ages of transition into each kin relation, the differences in average durations spent in each relation, and the ratios of lifetime probabilities of ever having transitioned into each relation (Table 2).

Table 2. Race differences in mean transition ages, durations, and lifetime transition risks by birth cohort

Relation[1]	Difference in starting age (white – black)	Difference in duration (white – black)	Lifetime risk ratio (black/white)
“Senior” Cohort: 1940-1950			
Grandparent	2.87	2.62	0.72
Parent	1.64	7.06	0.78
Sibling	0.13	15.32	1.00
Child	0.00	10.63	1.00
Grandchild	0.00	5.29	0.95
Former Parent	2.73	3.50	1.49
Former Sibling	12.32	-3.52	0.93
Grand Orphan	3.85	-2.37	1.12
Single Orphan	1.02	-0.39	1.20
Maternal Orphan	0.66	-0.11	1.31
Paternal Orphan	0.72	-0.19	1.25
Double Orphan	0.39	-0.22	1.96
“Adult” Cohort: 1980-1990			
Grandparent	3.06	2.86	0.75
Parent	1.67	9.33	0.79
Sibling	0.09	18.47	1.00
Child	0.00	12.08	1.00
Grandchild	0.00	5.60	0.95
Former Parent	4.94	5.08	1.41
Former Sibling	15.99	-5.73	0.91
Grand Orphan	4.03	-2.58	1.12
Single Orphan	0.63	-0.05	1.96
Maternal Orphan	0.11	0.40	1.27
Paternal Orphan	0.57	-0.05	1.38
Double Orphan	0.30	-0.10	1.24
“Youth” Cohort: 2000-2010			
Grandparent	3.43	1.83	0.83
Parent	1.87	7.19	0.82
Sibling	0.13	17.43	1.00
Child	0.00	12.37	1.00
Grandchild	0.00	5.35	0.95
Former Parent	2.65	3.63	1.19
Former Sibling	14.69	-6.51	0.92
Grand Orphan	3.83	-2..63	1.23
Single Orphan	0.94	-0.37	1.50
Maternal Orphan	0.16	0.31	1.70
Paternal Orphan	0.90	-0.41	1.57
Double Orphan	0.50	-0.37	3.03

[1] Orphanhood relations are measured only at pre-adult years (0-21 years).

For relations defined by living kin, the general pattern of earlier mean transition ages, shorter mean durations, and lower lifetime transition probabilities for black versus white individuals holds for each birth cohort. However, across cohorts, the magnitude of these differences undergo some changes: differences in mean transition ages increase, differences in relative transition risk decrease, and differences in mean durations first increase for the “adult” cohort (relative to the “senior” cohort) and then decrease for the “youth” cohort (relative to the “adult” cohort). For relations defined by deceased kin, race differences in average transition age, duration, and lifetime transition probability decrease on net over cohorts, but with notable exceptions for maternal orphanhood, paternal orphanhood and double orphanhood – all of which occur earlier, for longer durations, and more frequently for black individuals than white individuals over time.

Figures 7 and 8 present plots of age-specific probabilities of inhabiting select kinship relations (childhood, siblinghood, parenthood, maternal orphanhood, paternal orphanhood, and grand orphanhood) comparing the likelihood of black versus white individuals inhabiting those relations at each age. In contrast to the lifetime kinship durations presented in Figure 6, these are *unconditional* measures of kin availability: they characterize the likelihood at each age of inhabiting a particular kinship relation for *all* individuals in the population. Here, risk of orphanhood is measured across all years of life (not just pre-adulthood).

Figure 7. Probability of inhabiting select kinship relations defined by living kin (childhood, siblinghood, parenthood) by age and cohort.

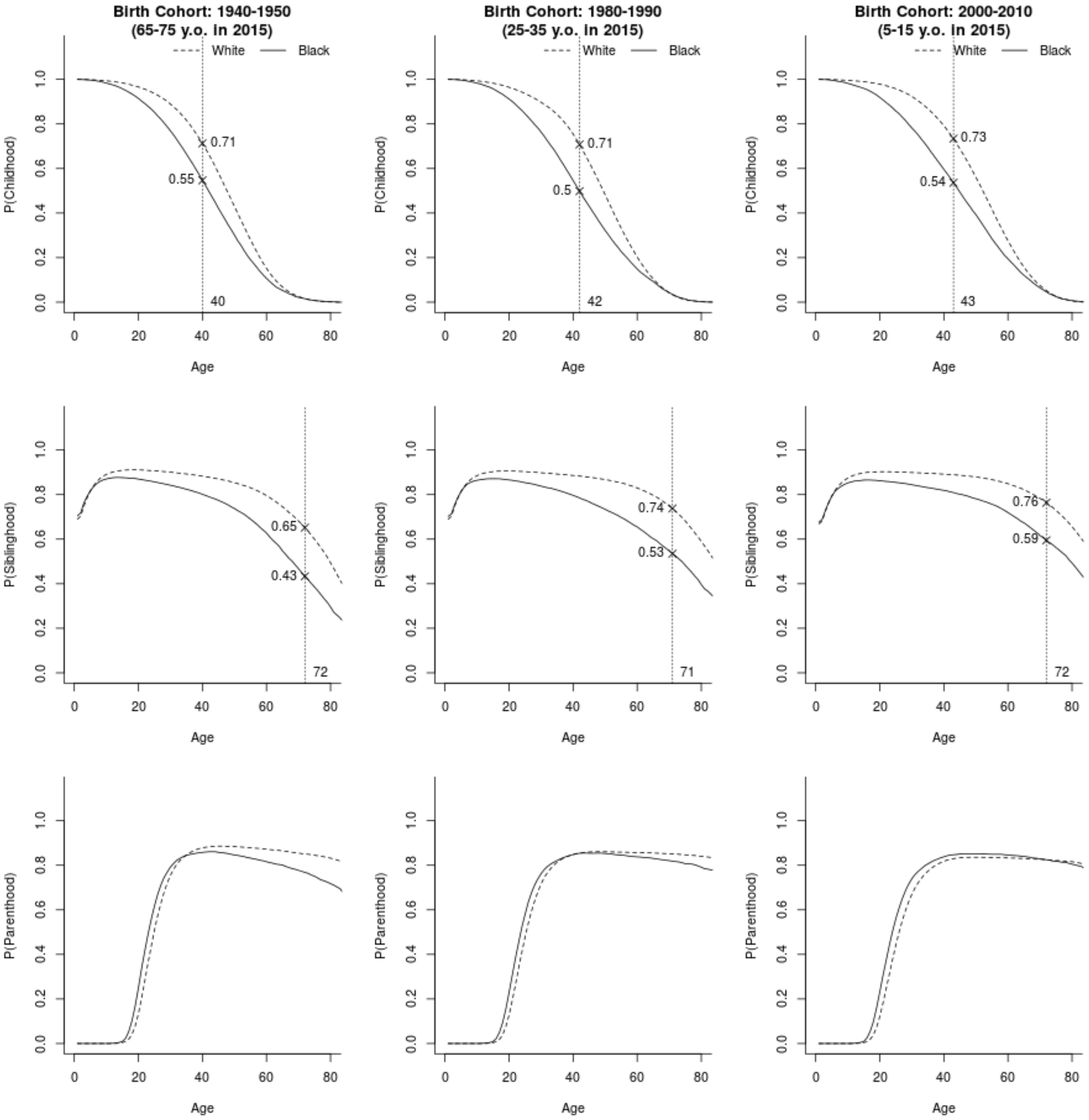
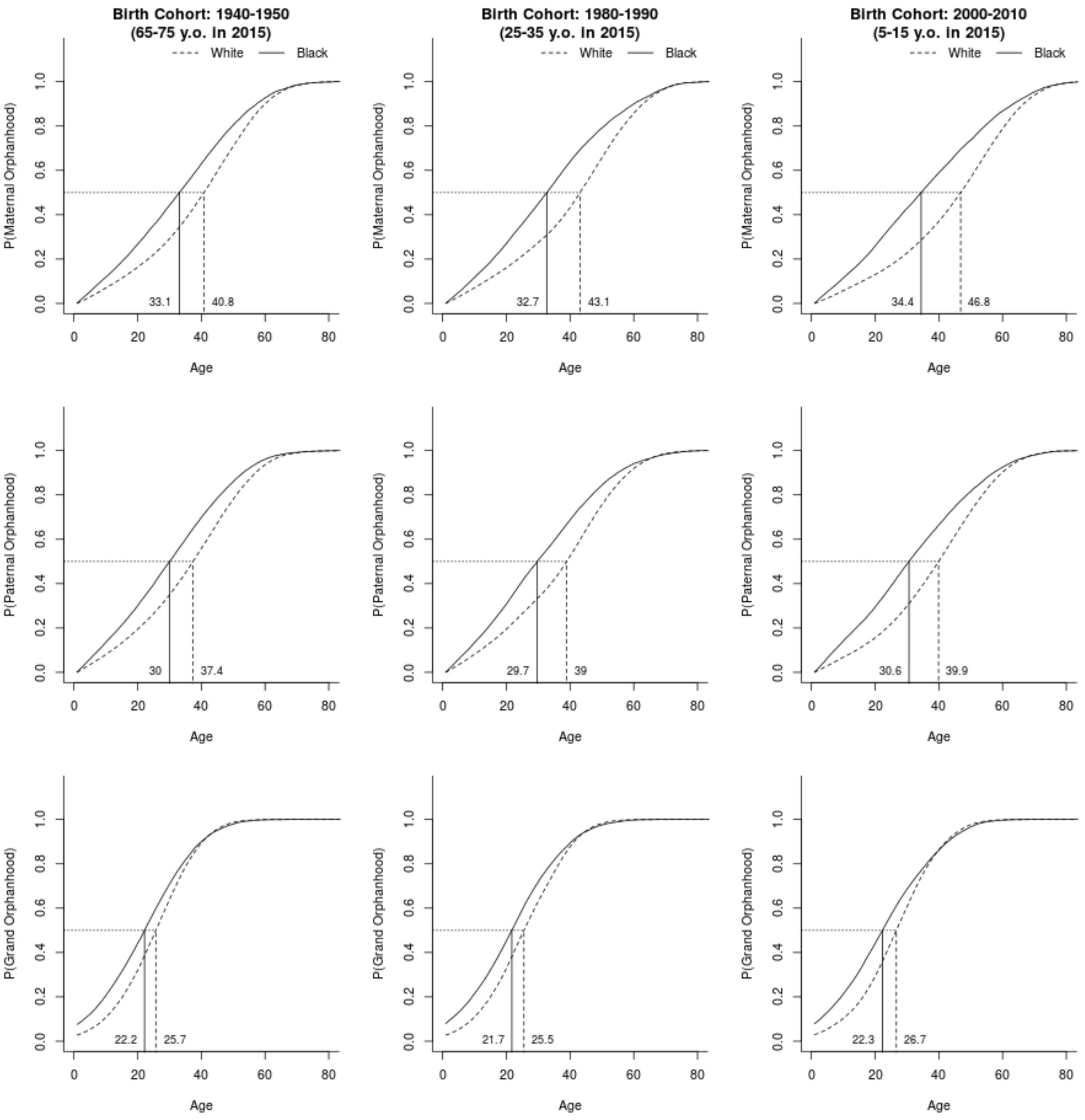


Figure 8. Probability of inhabiting select kinship relations defined by deceased kin (maternal orphanhood, paternal orphanhood, grand orphanhood) by age and cohort.



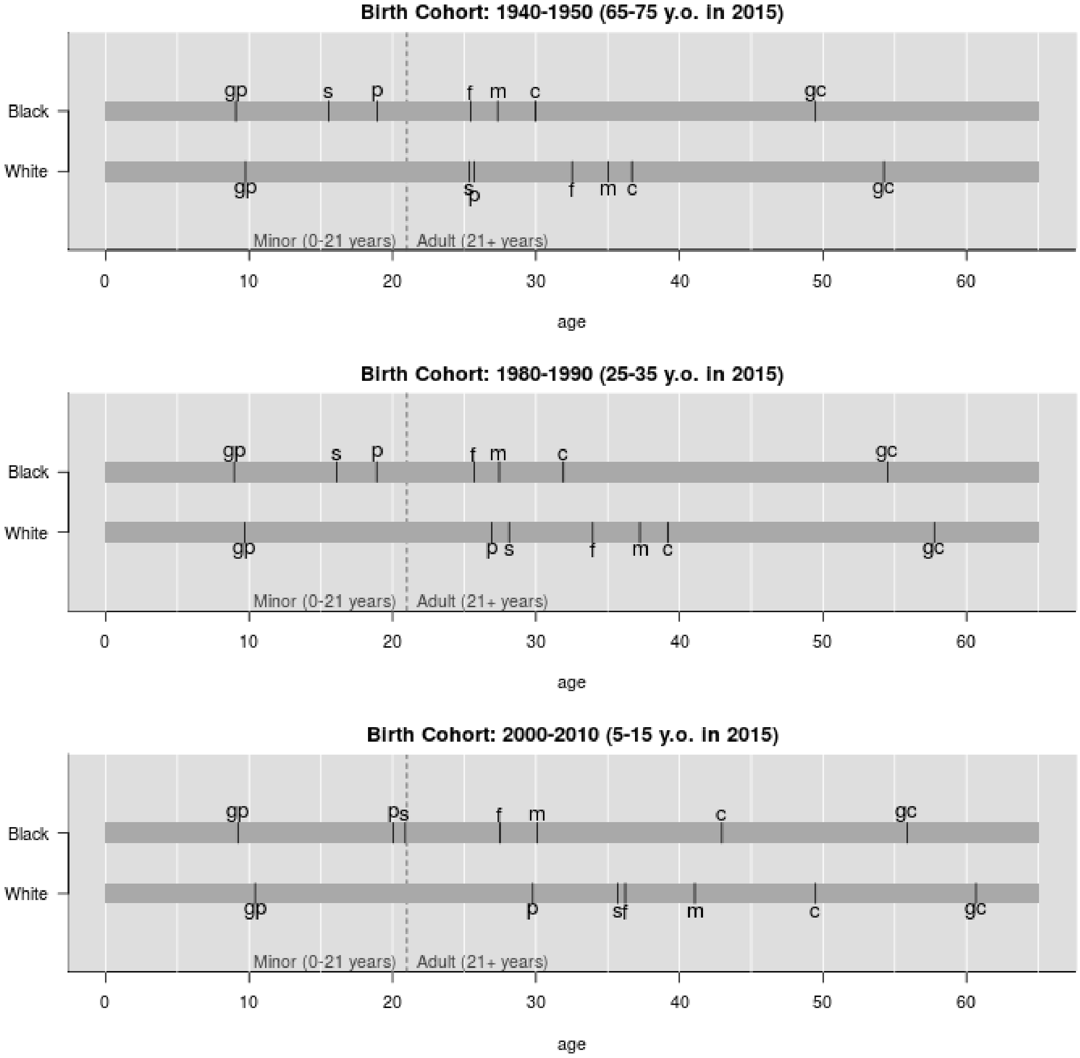
In general, black individuals are less likely than their white counterparts to inhabit kin relations defined by living kin, for most years of their lives (Figure 7). For example, at the point of greatest black-white difference (age 42), 55% of the black “adult” cohort are sons and daughters (i.e. co-existent with a living parent), while a substantially higher percentage, 71%, of the white “adult” cohort remain sons and daughters. Similarly, 53% of the black “adult” cohort are siblings (i.e. co-existent with a living sibling) at the point of greatest black-white difference (age 71), while 74% of the white “adult” cohort remain siblings at that same age. These trends reflect higher mortality among kin in the black population that make it less likely that different types of kin will be alive at each age to form the necessary relational linkages. The one clear exception to the general pattern seems to be for parenthood (i.e., co-existence of a living child): black individuals are more slightly more likely to be parents than their white counterparts until about age 40 when the pattern flips. This trend reflects higher fertility and mortality at earlier ages for the black population and higher fertility at later ages for the white population. For these kinship relations (childhood, siblinghood, and parenthood), race differences in the age-specific probabilities of kinship seem to remain consistently present for each birth cohort, but with evidence of some reduction over subsequent cohorts.

Turning to relations defined by deceased kin, we see that black individuals are at higher risk for maternal orphanhood, paternal orphanhood, and grand orphanhood at all ages, relative to their white counterparts. Thus, 50% of the black population in the “adult” cohort are maternal orphans by age 32.7, while the white “adult” cohort does not reach this proportion until 10.4 years later at age 43.1. Similarly, 50% of the black “adult” cohort are paternal orphans by age 29.7, while the white “adult” cohort does not reach this proportion until 9.3 years later at age 39. Finally, 50% of the black population in the “adult” cohort are grand orphans by age 21.7, while the white “adult” cohort does not reach this proportion until 3.8 years later at age 25.5. These race differences in age-specific orphanhood probability not only persist, but grow in magnitude over subsequent birth cohorts.

Life Course Expectations

To provide a more intuitive sense of how race changes the timing and sequence of kinship transitions over a lifetime, we examine the typical ages at which black and white individuals first experience the death of different kin (Figure 9). From this perspective we can see that the distribution of kin death is skewed heavily toward the earlier ages for black individuals relative to their white counterparts. This results in a situation where confrontation with familial death for all types of kin are likely to occur earlier for black individuals. For example, the first parental death in the life of an average black individual in the “adult” cohort occurs 8.02 years sooner. Perhaps more concerning is the higher frequency of kin deaths during the pre-adult years. By age 21, black individuals are likely to have seen a sibling, parent, and grandparent pass; while their white peers are likely to have only observed the passing of a grandparent. This race difference in ages at first death of kin is present in each birth cohort, but become less pronounced over subsequent cohorts.

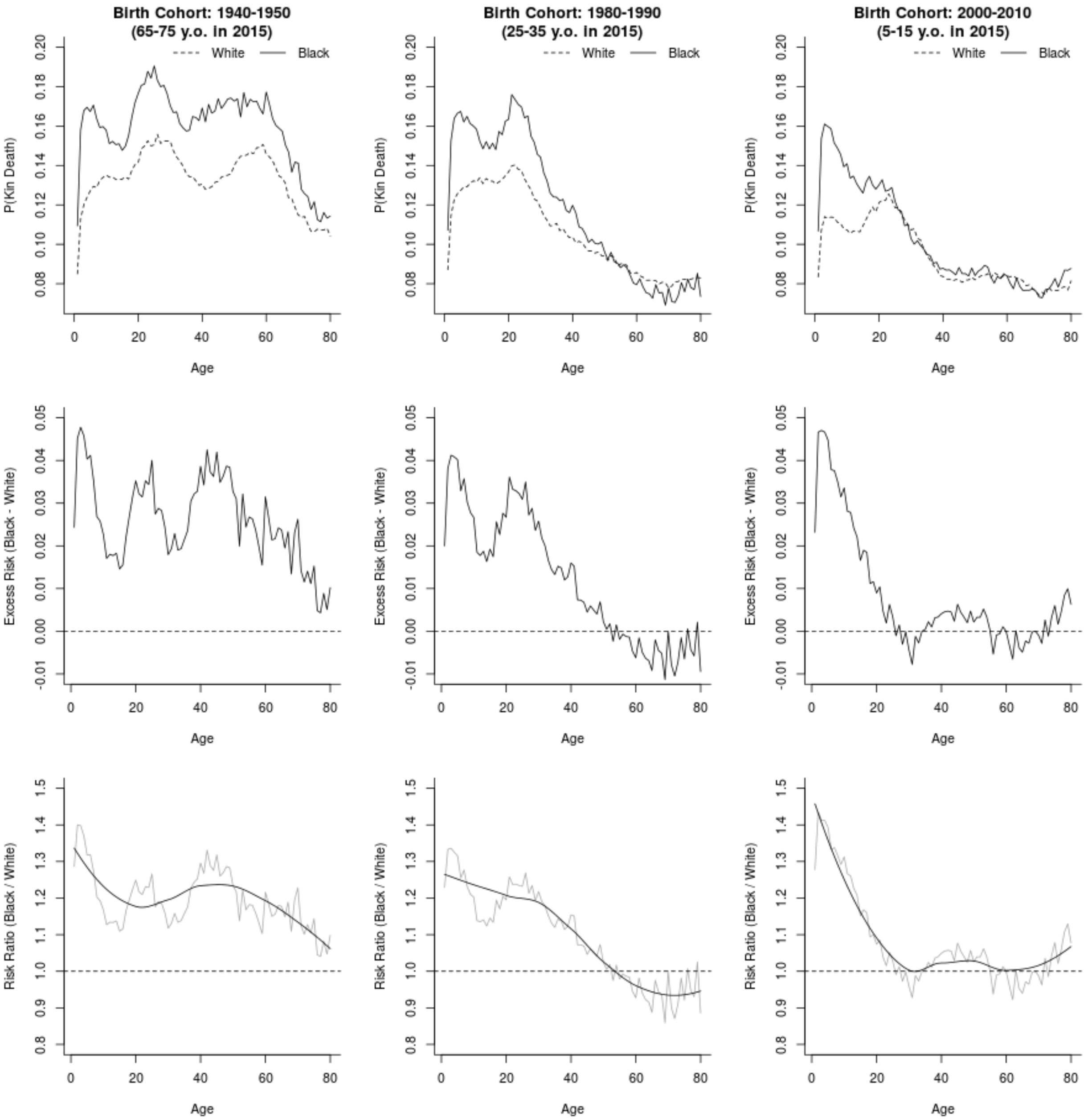
Figure 9. Mean ages at which death of different kin are first experienced (by race and birth cohort).



Relation	Label
Grandparent	gp
Parent	p
Mother	m
Father	f
Sibling	s
Child	c
Grandchild	gc

Figure 9 highlights the differences in likely sequence and spacing of kin deaths experienced over a lifetime, while Figure 10 highlights differences in the likely magnitude of exposure to those deaths at each age.

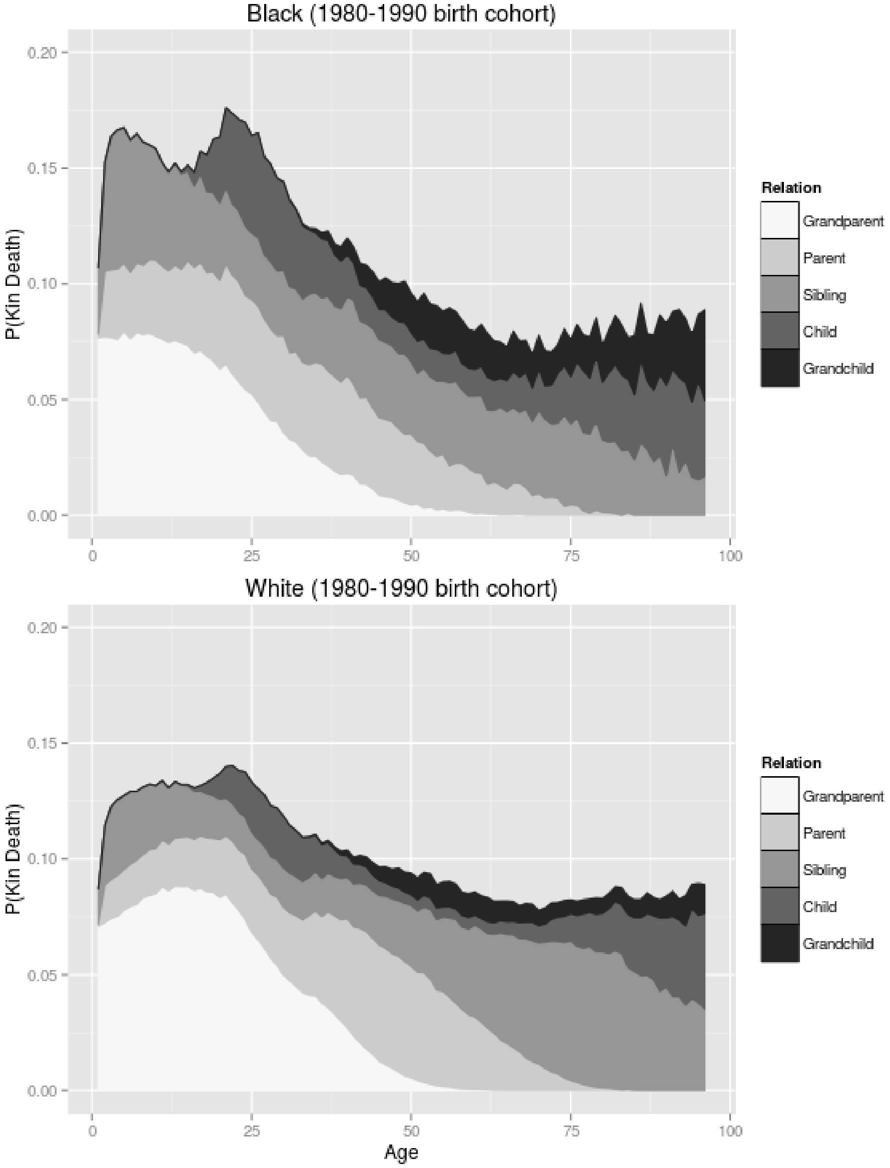
Figure 10. Probability of experiencing the death of select kin (grandchild, child, sibling, parent, and grandparent) by age. Top panel shows race-specific probability curves. Middle panel shows the absolute difference (black-white) of these probability curves. Bottom panel shows the ratio (black/white) of these probability curves: the jagged gray curve represents the raw ratios at each age, and the solid black curve is a LOESS smoother applied to the raw ratios.



Examining the aggregate risk of death for a set of close kin (grandchildren, children, siblings, parents, and grandparents), we see that black individuals are more likely than their white counterparts to experience kin death at nearly every age. By age 60, black individuals in the "adult" cohort have been exposed to 1.14 times higher risk of kin death, on average, at each age – resulting in 105.8% more (excess) kin deaths. Overall, this race difference in kin mortality seems to become less pronounced over subsequent cohorts (with even some crossover at older ages for the "adult" and "youth" cohorts). However, the relative gap at the earliest ages remains high without any clear indication of convergence over time: By age 21, the average black individual in the "senior", "adult", and "youth" cohort is likely to have been exposed to risk of kin death 60%, 58%, and 58% in excess of what the average white individual is expected to have experienced.

Finally, we decompose the aggregated risk of kin death into kin-specific risks (Figure 11). Doing so, we see that the black and white aggregate curves differ not only in their shape and magnitude, but by the relative contributions of risk due to different types of kin death. Notably, deaths of parents and siblings tend to be more important sources of familial mortality exposure in the pre-adult years for black minors than for their white counterparts such that roughly a third of all kin death experienced by black minors are the deaths of parents and siblings, while parents and siblings represent only about a fifth of the deaths experienced by white minors. This pattern remains relatively constant across all birth cohorts.

Figure 11. Probability of experiencing the death of select kin (grandchild, child, sibling, parent, and grandparent) by age, decomposed into constituent relations. Race-stratified plots for the other two birth cohorts show similar patterns.



Discussion

So what do all of these differences mean? In concrete terms, it means that black Americans were likely to have had fewer available kinship resources at most ages relative to their white peers throughout most of the past century, leading to earlier orphanhood, lower lifetime probabilities of transitioning into most kinship relations and shorter durations spent in them once there. By age 21, black Americans born in the period 1940-1950 are likely to have suffered 60% more familial deaths, on average, than white Americans born in the same period, and they are likely to have experienced these deaths at much earlier ages. Sixty years later, the trend is expected to persist: 58% more familial deaths experienced by black minors born in the period 2000-2010.

These findings largely corroborate those reported by Ruggles (1994). In particular, the evidence I find for increasing race differences in orphanhood at pre-adult ages is consistent with the observed pattern of increasing proportions of single parent families among black American households (Ruggles 1994). Though recent research on parental absenteeism has focused on low marital rates, divorce, separation, and incarceration, the present study demonstrates the continuing importance of parental mortality in the continuation of this trend.

While the consistently large and growing race differences in orphanhood outcomes merit considerable concern and attention, the majority of the race gaps observed for other kinship relations display signs of slow convergence over time: Black-white differences in lifetime and age-varying probabilities of transition into these kin relations as well as differences in the time spent in them seem to shrink, on net, over successive birth cohorts. These patterns of growing similarity are an encouraging counter-point to the orphanhood case, especially since they more directly relate to the greater part of our lives (i.e. very few person-years are spent in pre-adult orphanhood).

~

In this work I have defined the concept of *kinequality* to mean differences in kinship due to differences in demography. In this context, the slow convergence in familial life course trajectories reflects and is derivative-of the slow convergence in black-white trends in overall fertility and mortality. Irregularities in this convergence are a product of variations introduced by persistent black-white differences in births and deaths of kin at specific ages. This mechanical relationship between demography and expected kinship trajectory is the defining feature and strength of the kinequality concept.

Kinequality provides analytically-tractable insights into the ongoing impact on family life due to the making and breaking of kinship ties by birth and death. In this vein, the death of an individual is understood not only as the ultimate disruption in the life of the recently-deceased, but as a potential source of ongoing disruption for her family and future generations. The major forms that this disruption can take are: altered kin availability and altered familial life course expectations. These are the two dimensions of kinequality that I have discussed in this work, and have characterized for historic black and white American populations. Kinequaility does not *necessarily* lead to realized inequalities in family and wellbeing, but it crucially demarcates the genealogical boundaries within which those inequalities must be negotiated.

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APPENDIX

A1. *Calibration of SOCSIM via Maximum Likelihood Estimation*

In order to recover results that are consistent with observed data, I calibrate my input rates against the known distribution of family sizes and life expectancies (TFR and e_0) at each ten-year interval from 1910 to 2009. This calibration is done via two scaling factors – θ_m and θ_f – that multiplicatively adjust the levels of the age-specific mortality and fertility inputs, respectively. What is thus assumed is confidence in the general shape of the age-specific mortality and fertility curves, but uncertainty regarding their magnitudes (Figure 1).

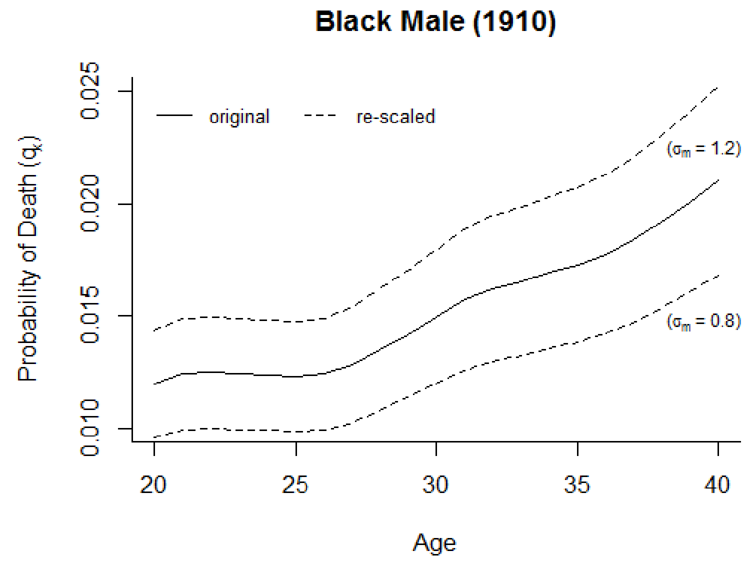

Figure 1. Example of re-scaled age-specific mortality curves. The area between the dashed lines demarcate the range of possible re-scaled values.

Procedurally, twenty candidate values are chosen (at even intervals) between the range 0.80 to 1.20 for each θ_m and θ_f parameter. This results in 400 possible (θ_m, θ_f) pairs. Each of these pairs are applied to the simulation's 11 sets of mortality and fertility inputs, and the simulation is then run to completion 25 times (for each pair of scaling factors) producing 25 unique values of TFR and e_0. The variation and average of these outcomes over the 25 runs is used to compute a likelihood estimate of observing the true values of the outcomes assuming that the simulated outcomes are normally distributed. In sum, what is produced is an estimated likelihood surface that varies by θ_m and θ_f for each of the 11 input rates used in the simulation (Figure 2). The (θ_m, θ_f) pair that generate the highest likelihood value is then chosen as the final re-scaling parameter set.

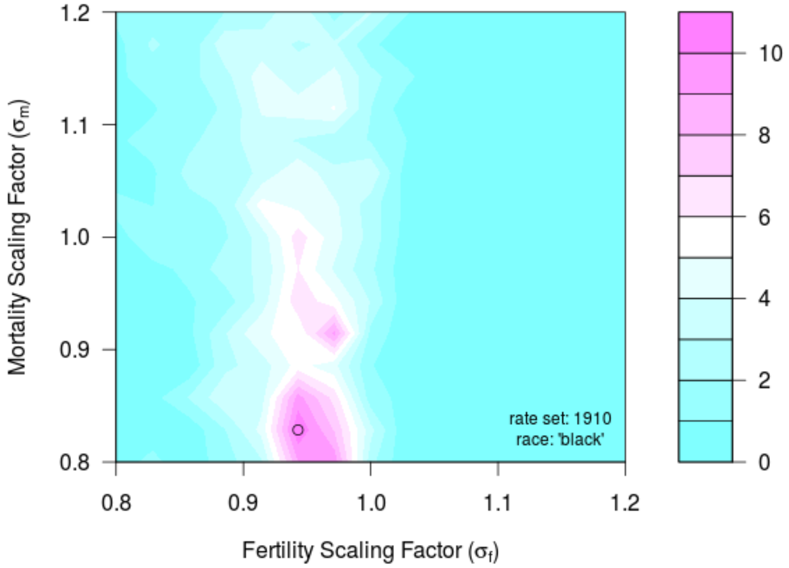

Figure 2. Example of estimated likelihood surface generated by the calibration procedure. The point marked by the hollow dot represents the (θ_m, θ_f) pair associated with the maximum likelihood value.

Thus in sum: (11 simulation input rate sets) x (400 re-scaling pairs) x (25 random simulations) = 110,000 calibration simulations are conducted to arrive at a final set of 11 re-scaling parameters. In concert, these 11 re-scaling parameters applied to our simulation's fertility and mortality inputs do a competent job of reproducing the expected TFR and e_0 values (Figure 3).

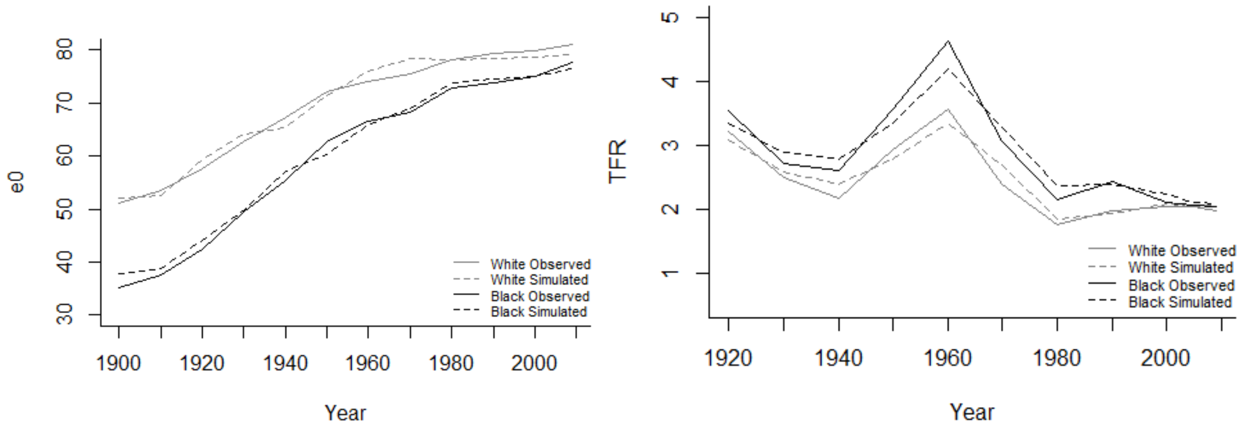

Figure 3. Period female life expectancy (e_0) and total fertility rate (TFR): observed and simulated values.

Traditionally, calibration of this sort has been done via an informed trial-and-error methodology, but advances in computational power allow for more systematic optimization procedures, such as the one presented here (for similar applications see: Ševčíková, Raftery, and Waddell 2007; Zagheni 2011). That being said, the need for these calibration steps should alert the reader to the danger of placing too much confidence in the exact magnitudes of effect being reported here (or in any other microsimulation study). These concerns, however, should be much less pronounced when considering the relative differences between two identically-configured simulations that vary only in their initial inputs as is the case in the present study.

A2. *Summary of simulation input parameters (by race)*

White American

		Life Expectancy at Birth (e_0)	
Period	Total Fertility Rate (TFR)	Male	Female
1900-10	3.219	48.23	51.08
1910-20	3.219	50.23	53.62
1920-30	3.219	55.30	57.52
1930-40	2.506	59.12	62.67
1940-50	2.177	62.81	67.29
1950-60	2.945	66.31	72.03
1960-70	3.576	67.55	74.19
1970-80	2.405	67.94	75.49
1980-90	1.759	70.82	78.22
1990-2000	1.989	72.72	79.45
2000-09	2.049	74.78	79.99
2009-beyond	1.990	76.40	81.20

Black American

		Life Expectancy at Birth (e_0)	
Period	Total Fertility Rate (TFR)	Male	Female
1900-10	3.556	32.54	35.04
1910-20	3.556	34.05	37.67
1920-30	3.556	40.45	42.35
1930-40	2.734	47.55	49.51
1940-50	2.618	52.26	55.56
1950-60	3.579	58.91	62.70
1960-70	4.647	61.48	66.47
1970-80	3.077	60.00	68.32
1980-90	2.154	64.10	72.88
1990-2000	2.454	64.47	73.73
2000-09	2.121	68.17	75.16
2009-beyond	2.048	71.10	77.60

NOTE: 1920 fertility rates used for earlier periods due to data inadequacy