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Boris Mints Institute Progress Report

Brief Background

Inequality in lifespan has been called the most fundamental inequality, since 'every other inequality is conditional on being alive' (Van Raalte, Sasson & Martikainen, 2018). Patterns of lifespan inequality vary between and within countries and vary significantly by sex, race, and educational attainment (Permanyer and Scholl, 2019; Firebaugh et al, 2014; Sasson, 2016) among other factors. Though demographers have long documented inequalities in longevity and lifespan variation on the population level, do *individuals* experience inequalities in their *perceived* longevity?

The question of how individuals internalize their demographic reality—mortality rates in particular—has been the subject of much speculation (Wilkinson 2002, 57). Mortality rates that are two, three, or four times higher in one social group compared to another is not unheard-of in contemporary high-income countries. For example, African-Americans are three times more likely than their white counterparts to experience maternal loss by the age of ten (Umberson et al. 2017). How does excess exposure to mortality shape individuals' perceived longevity, that is, their own survival expectations and subjective life expectancy? To address this question, I focus on lifespan inequality in the U.S., specifically the black-white gap and educational gradient. By comparing expected survival between groups, we can further understand individual experience of lifespan inequality.

Methods

Data

To calculate expected survival, I use the *Health and Retirement Study* (HRS), a nationally representative survey of individuals over age 50 and their spouses. In the first survey in 1992 (called the HRS cohort) respondents were asked: "What do you think the chances are you will live to age 75 or more? Where 0 is absolutely no chance, 10 is absolutely certain." This question was repeated also with respect to living till age 85. I use these two probabilities to calculate expected survival, closely following the methods of Perozek (2008).
In the 1992 survey there were n= 12,652 respondents. I concentrate on those born between 1931-1941; n= 9,824 respondents, 7,733 White/Caucasion, and 1,707 Black/African American.

Calculating Subjective Survival Functions

From respondents' answers, the subjective probability of surviving to age 75 and 85 is denoted $P_{75,\,age_i}$ and $P_{85,\,age_i}$, respectively. The next step follows Perozek (2008) techniques, she starts by changing the probability to a scale of 100 (as opposed to 10) and making adjustments to satisfy biologically logical conditions. Since for each individual we are given two points, I fit a cumulative survival distribution function for each individual. In other words, given for each individual the probabilities of surviving from some current age to age 75 and to age 85, I can estimate the parameters of a function that calculated the probability of surviving at each age, based on the given values. I use a Weibull distribution as the survivor function:

$$S_{i,t}(\alpha_i, \beta_i) = e^{-\frac{t-age_i}{\alpha_i}^{\beta_i}}$$

Where each individual i, at their age at the time of the survey, age_i, will have parameters α_i and β_i for their Weibull cumulative survival function fit to their subjective survival probabilities. Nonlinear least squares (NLSS) regression is used to estimate α_i and β_i so that

$P_{75,85,110} = S_{i,t}(\alpha_i, \beta_i)$, for some age $age_i \in [50, 61]$
And then α_i and β_i are used to yield cumulative survival for each individual, that is $S_{i,t}$ for $t \in [age_i, 110]$.

Grouping Ages
Unlike Perozek, I stratify the population by race and educational attainment, therefore, to increase the power of our results, respondents ages 51-55 and 56-60 were grouped together. Although life tables are generally sensitive to each age, the life tables to be formulated here are based on predictions of survival ten to fifteen years into the future. We assume a 51 years old's prediction of survival at age 75 will not change much in four years' time. Comparisons of the calculated survival curves between each age confirm this assumption, as do comparisons of respondents answers at each age.
To group the ages, the cumulative survival at each age is normalized to age 55 for the first group, and 60 for the second group. That is, for each individual i the normalized survival, $S_{i,t,\,group_j}$ is equal to:
$S_{i,t,\,group_1} = S_{i,t} / S_{i,\,55}$ for ages 51-55
And
$S_{i,t,\,group_2} = S_{i,t} / S_{i,\,60}$ for ages 56-60
These cumulative survival probabilities are multiplied by the HRS supplied person-level weights ($S_{i,t,\,group_j} * W_i$) which establishes that W_i people are alive in 1992 (age_i) decreasing with the survivor function till age 110. These individual cohorts are summed for each age- group and variable of interest (race, gender, education level) to generate the number of persons expected to be alive at each age, or l_x, in the nomenclature of life tables. From l_x all other life table values are derived, including life expectancy.

Results thus far

Gender differences

The *difference* in perceived remaining life expectancy between men and women at age 60 start at about 1.6 years and 1.3 years for the 1937-1941 birth cohort and the 1932-1936 birth cohort, respectively (Figure 1). This difference is about half the difference reported by the U.S. Social Security Administration (SSA) for the same birth cohorts (Bell and Miller 2005). At age 60 the difference in the SSA reported average life expectancy for each gender was about 3.6 and 3.7 years for the two groups of birth cohorts (Table 1). For women the average perceived life expectancy was also 1 to 2 years greater than the reported SSA LE, whereas men are slightly more optimistic; their perceived life expectancy was 3 to 4 years greater.

Race and gender differences

In both the black and white cohorts, the women have greater average expected remaining life (Figure 2) which reflects demographic reality. However, on average we see that black men and women expect greater survival and life expectancy than their white counterparts, which is contrary to demographic measures. This phenomenon is in large part due to black respondents predicting a 100% chance of surviving to age 85 twice as frequently as white respondents

(Figure 3B). More predictions of 100% survival for black respondents than for white holds true for both males and females, and for the chance of surviving to age 75 as well.
Male-female differences in reported life expectancy for both black and white individuals average about 4 years at age 60 (Vital Statistics Report, 1992). I found the subjective life expectancy to differ by 1.5 years for whites and about 0.5 years for blacks at age 60.

Education level differences

The subjective life expectancy for those with a year of college or more (13+ years of schooling) till age 80 is greater than the other education levels (Figure 4). The subjective life expectancies for both cohorts are nearly equivalent for those with a high-school degree (12 years of schooling) and those with less schooling (0-12 years of schooling), which differs from reported lifespan inequalities based on education (Sasson, 2016). Since black individuals more often answered with a 100% chance of survival in the survey questions, I also excluded them from the education analysis (Figure 5) and found only a slight difference in the subjective life expectancy for those with a high-school degree and those with less schooling.

Brief discussion

So far, I found that disadvantaged groups tended to be optimistic about their mortality prospects, and in one case, with race, that the inequalities in perceived life expectancy switched direction. Although it would be nice to assume that disadvantaged groups are not experiencing or internalizing the lifespan inequalities, they have historically been subject to, it would be incorrect. We cannot assume that more answers of 100% survival chances equates to optimism of longevity. The phenomena of probability questions concentrating at focal points (0, 50%, 100%) has been noted before (Hunyh and Jung, 2011; Kleinjans and Soest, 2014; Wise, Gan and Hurd, 2013). Possible reasons for the phenomenon include not understanding probabilities, and very strong rounding. However, I have yet to find a precedent for race differences in survival probability estimating, and I found that more black individuals specifically chose 100% chance as opposed to the other focal points. This finding contributes to subjective survival probability literature, since on average, populations have been found to have predictive power of their longevity (Hurd and McGarry, 2002). However, the accuracy of self-made longevity predictions has not been confirmed across many subgroups, and it has previously been reported that individuals with lower levels of education less accurately predict their mortality (Bago d'Uva, 2015). Further research is required to understand how predictions of survival and life expectancy differ by race.

Further work to be done

1) Incorporate objective life expectancy and survival rates from Vital Statistics data (with a similar methodology that I used above) for comparisons with the subjective life expectancies and survival rates.
2) Calculate the actual survival of the cohorts until 2019 (most current HRS data) and compare with corresponding SLE, for gender, race and education level.
3) Investigate the different methodologies to calculate variance in subjective life expectancy and compare with actual cohorts' variance.

4) There are a large number of NAs for the probability questions, about 7% of respondents. I would like to analyse which individuals are declining to answer those questions.

Tables and Figures

	Men				Women			
	Birth cohort 1937-1941		Birth cohort 1932-1936		Birth cohort 1937-1941		Birth cohort 1932-1936	
Age	Weibull SLE	SSA LE	Weibull SLE	SSA LE	Weibull SLE	SSA LE	Weibull SLE	SSA LE
60	24.09	20.27	23.25	19.82	25.62	23.83	24.5	23.49
65	20.26	16.72	20.02	16.36	21.64	19.89	21.29	19.59
70	16.90	13.57	16.53	13.25	18.07	16.29	17.75	16.00
100	5.14	2.542	5.12	2.45	5.20	2.91	5.3	2.81

Table 1. Comparisons of subjective life expectancy (SLE) for each gender and select birth years to life expectancy reported by the SSA (Bell and Miller 2005).

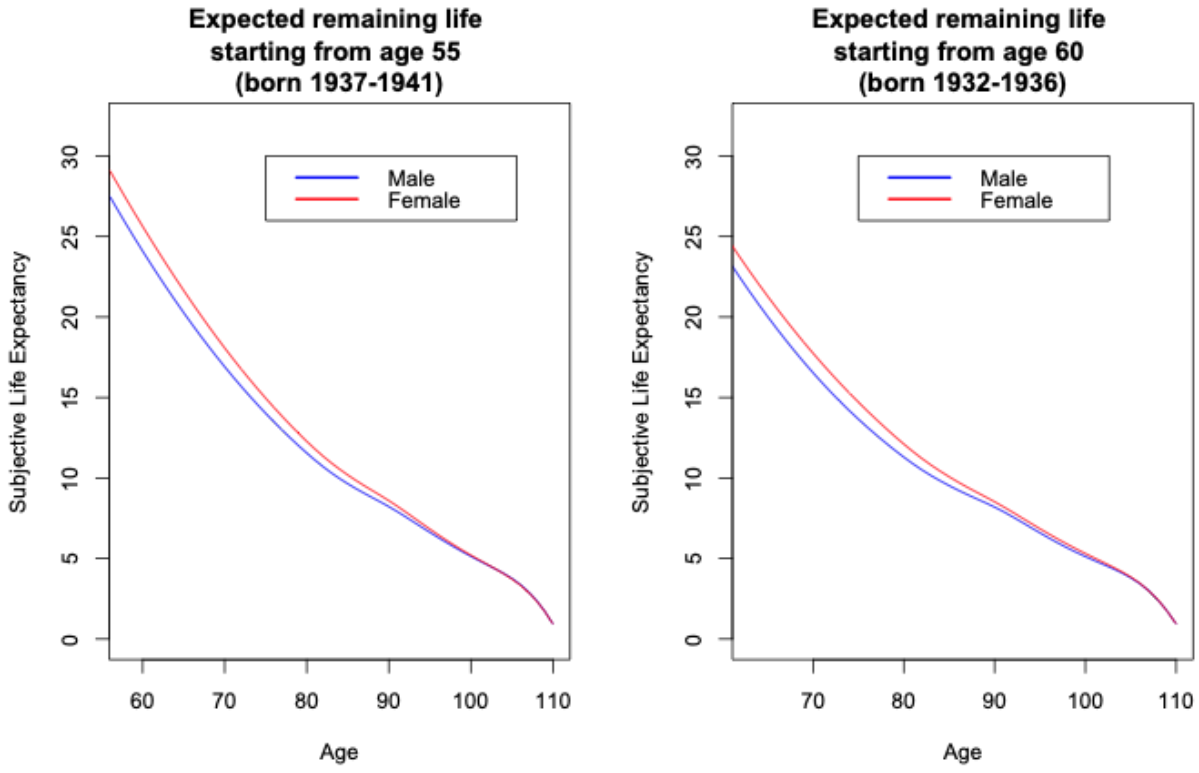


Figure 1. Subjective life expectancy of men and women from age 55 (those born between 1937 and 1941) and from age 60 (those born between 1932-1936).

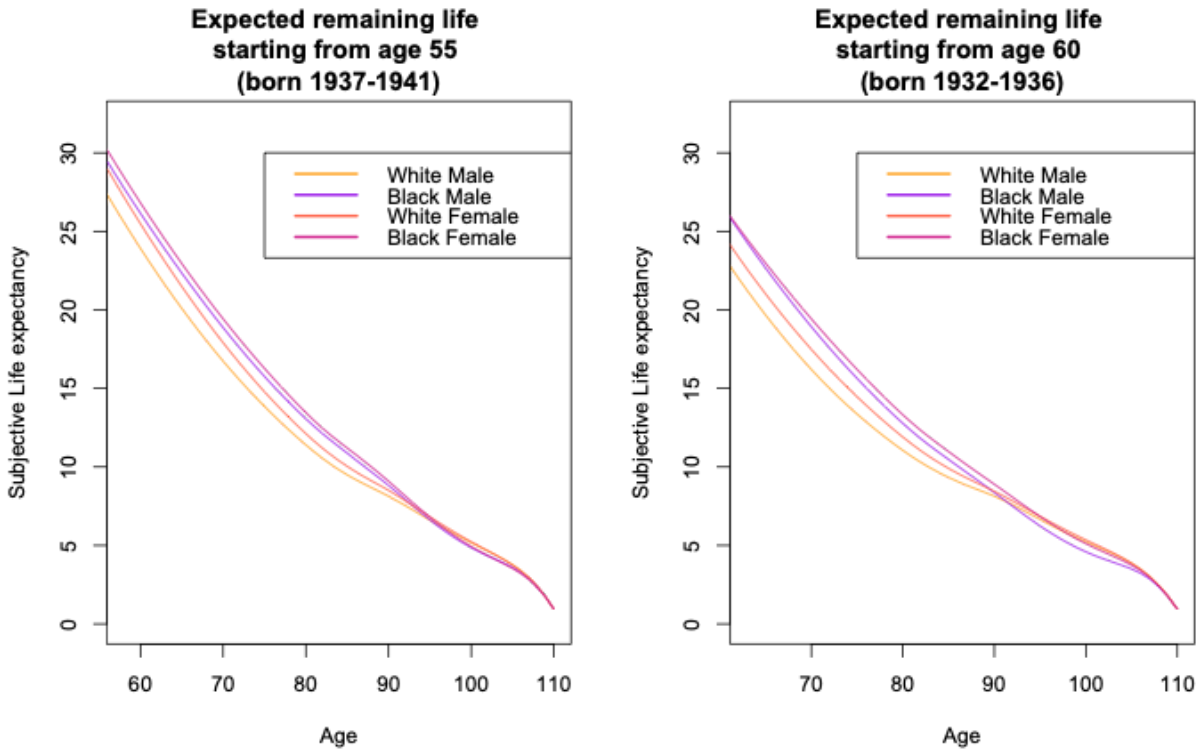
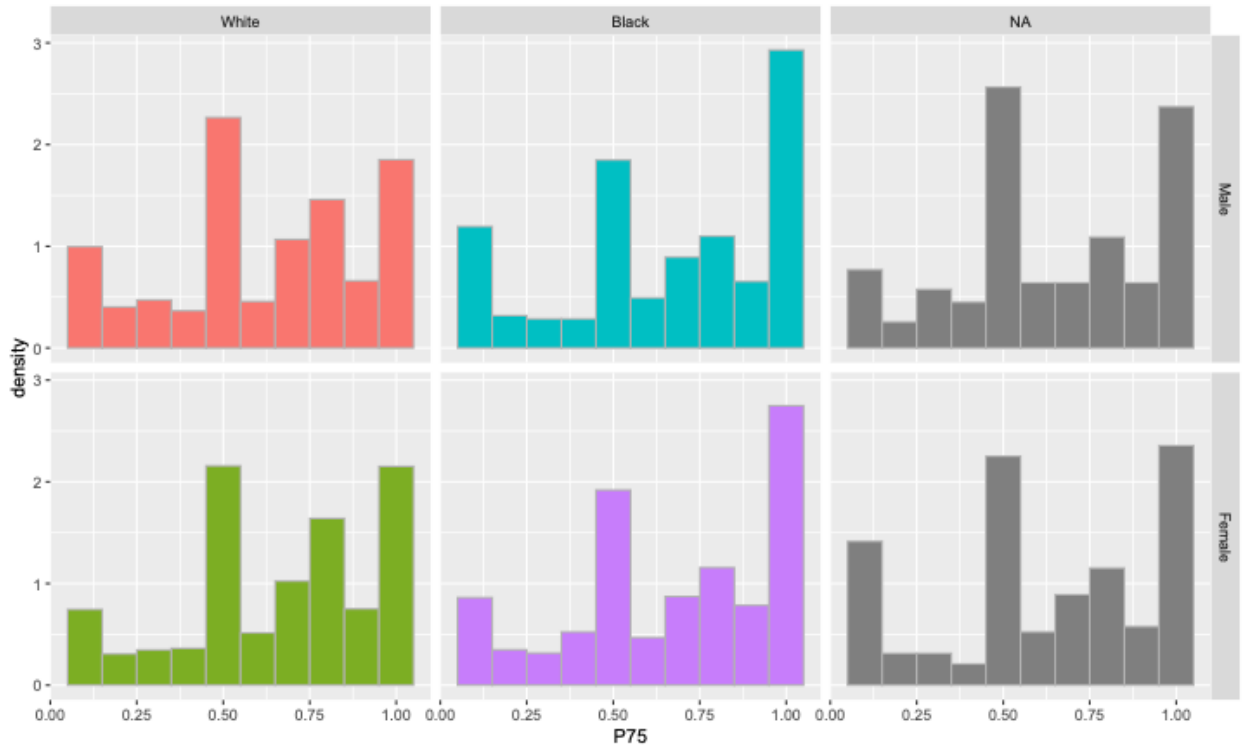


Figure 2. Subjective life expectancy for white and black men and women from age 55 (those born between 1937 and 1941) and from age 60 (those born between 1932-1936).



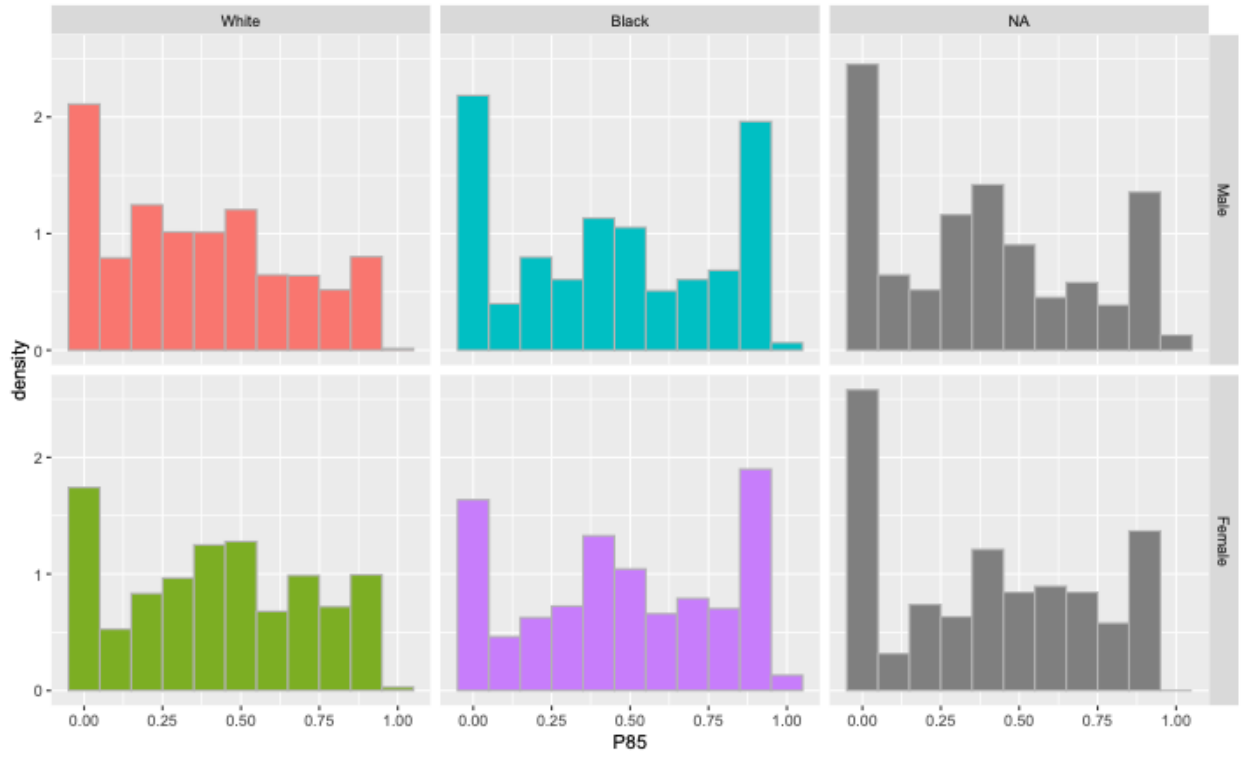


Figure 3A and 3B. Histograms of respondents predicted probability of surviving to age 75 (3A) and age 85 (3B).

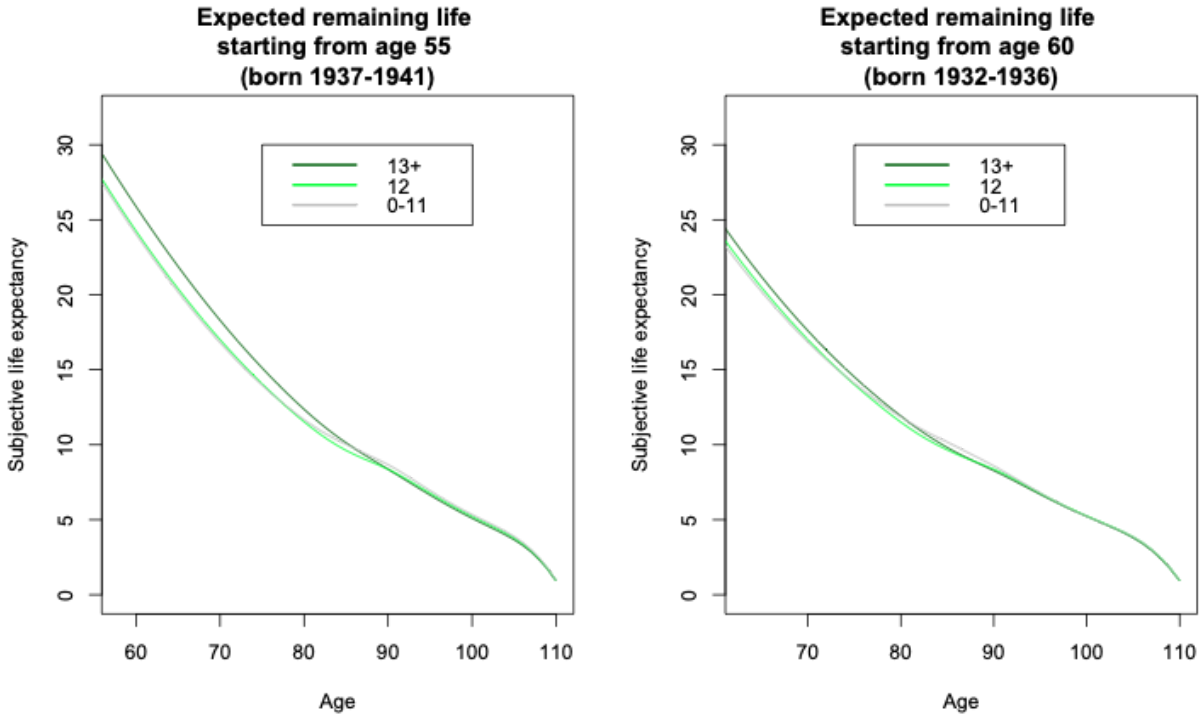


Figure 4. Subjective life expectancy for from age 55 (those born between 1937 and 1941) and from age 60 (those born between 1932-1936) for three different education levels: Those with some college or above (13+ years of schooling), those who finished high school (12), and those with less than high school (0-11 years of schooling).

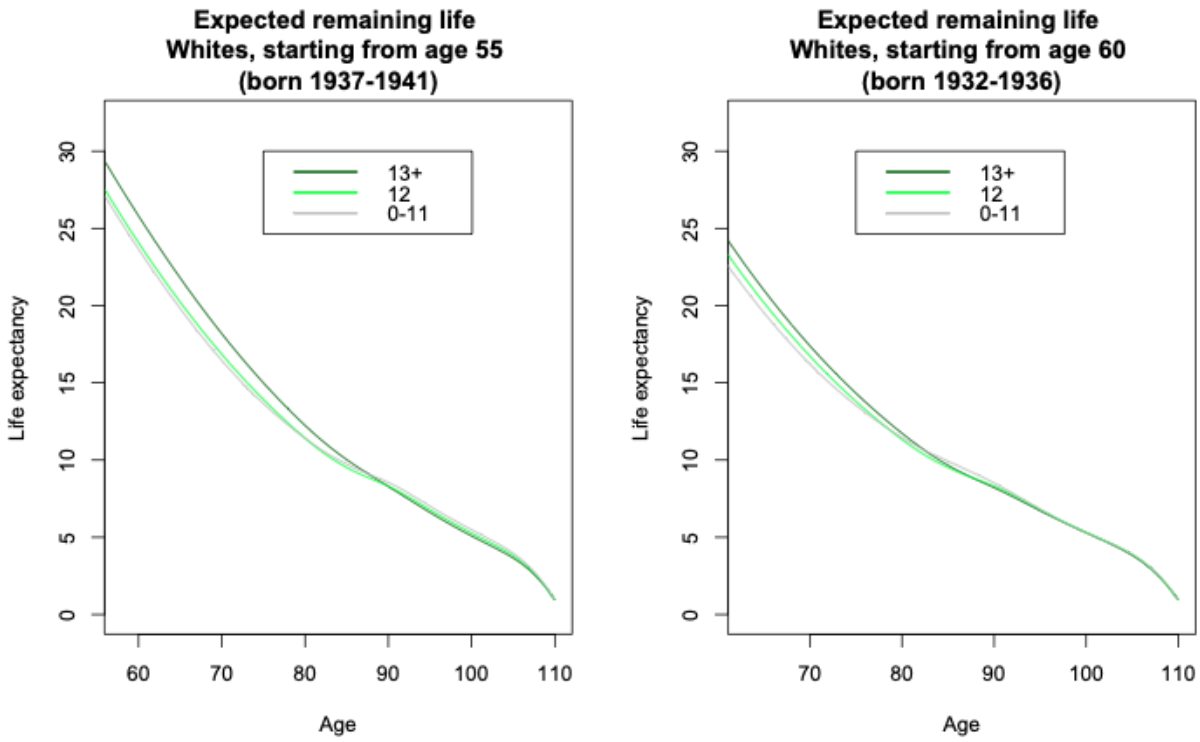


Figure 5. Subjective life expectancy of white people (born between 1937-1941 and 1932-1936) for three different education levels: Those with some college or above (13+ years of schooling), those who finished high school (12), and those with less than high school (0-11 years of schooling).

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