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The educational, racial and gender crossovers in life satisfaction: Findings from the longitudinal Health and Retirement Study

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Abstract

Objective—To examine variations in life satisfaction by education, gender, and race/ethnicity over a period of eight years among middle-aged and older Americans.

Methods—Mixed-effects models were used to analyze five waves (2006, 2008, 2010, 2012 and 2014) of longitudinal data from 16,163 participants born 1890–1953 in the U.S. Health and Retirement Study.

Results—Life satisfaction was higher in older adults, and the Great Recession had great impact on life satisfaction. Crossover interactions were found by gender, education, and race/ethnicity. Higher education was associated with higher life satisfaction for both genders, with stronger effects for females. Hispanics had the higher level of life satisfaction than non-Hispanic Whites and African Americans.

Discussion—Longitudinal evidence revealed disparities in life satisfaction. The racial/ethnic differences in the impact of education suggest that the economic and health returns of education vary by social group. Researchers should continue to examine reasons for these disparities.

Keywords

Subjective well-being; Older adults; Education; Gender interaction; Longitudinal analysis

1. Introduction

Americans are living longer than ever, it is essential to examine if they live a better quality of life when they get older. One approach to assess whether people have a good quality of life is to rely on their subjective perception of well-being (Diener & Suh, 1997). Subjective well-being (SWB), defined as an individual's global evaluation of all aspects of his/her life

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Conflict of interest

The authors declare no conflict of interest.

(Diener, 1984), is often conceptualized to have a cognitive component that evaluates one's overall life satisfaction (LS), domain-specific satisfaction (toward family, work, health, finances, etc.), and an emotional component that relates to a person's affective state (i.e., personal happiness) (Diener, Suh, Lucas, & Smith, 1999). LS constitutes the cognitive dimension of SWB and refers to individuals' global evaluation of their own lives (George, 2010), and it is the focus of this study.

Guided by the life course perspective (Elder, Johnson, & Crosnoe, 2003), this study aims to examine how patterns of life satisfaction are structured by individual lives and the historical and socioeconomic context in which their lives unfold. Accordingly, we choose to focus on age cohorts, which link age and historical time, as well as socio-demographic factors such as education, race, and gender that largely determine individuals' social pathways.

In terms of age differences in SWB, it is intuitively expected that, with the increase in risks and losses associated with advancing age, it becomes difficult to maintain SWB (Baltes & Baltes, 1993). However, there is evidence suggesting that older adults are more satisfied with their lives than young adults and middle-aged adults (Blanchflower & Oswald, 2008; Campbell, Converse, & Rodgers, 1976). The maintenance of SWB despite age-related changes or declines in life circumstances, such as health and income among older adults, is known as the paradox of well-being (Kunzmann, Little, & Smith, 2000; Mroczek & Kolarz, 1998). A recent large-scale cross-sectional study based on the European Social Survey confirmed the U-shaped happiness-age trajectory with a dip in the age 50 s among affluent countries such as United Kingdom, Italy and Spain. However, when individuals with more advanced age were examined, another dip in SWB was found in the age of late 80 s (Morgan, Robinson, & Thompson, 2015), which implies that the age-related paradox in LS may not hold in the oldest-old. An analysis of data from the Household, Income, and Labor Dynamics in Australia (HILDA) revealed the same pattern of two dips in LS at the age 50 s and late 80 s (Segerstrom, Combs, Winning, Boehm, & Kubzansky, 2016). These findings suggest that, even in late life, there might be noticeable variations in LS by age that warrant further examination. Besides age, another associated factor is cohort. Different age cohorts tend to utilize different experiences and resources to respond to the same historical event or condition, resulting in cohort-patterned LS trajectories. For instance, a study found that economic context affects older people more than younger people (Swift et al., 2014).

Besides age cohort, we also focus on education. Education is stable across one's life course, and it is a universal indicator of socioeconomic status as it enhances human capital that remains in individuals despite retirement and reduction in income in late life (Mirowsky & Ross, 2003b). Although the association between education and health is one of the most powerful and robust relationships in social science (Lynch, 2003), the relationship between education and LS is more complex and less straightforward because education increases both opportunities and aspirations that may lead to contradictory effects on LS (Ferrante, 2009). Opportunities and aspirations, in turn, are likely to be contingent on factors such as gender and race/ethnicity.

Gender differences in SWB are also complex because of the gender-age interaction (Inglehart, 2002; Plagnol & Easterlin, 2008; Yang, 2008), as well as societal differences in

gender equality (Tesch-Romer, Motel-Klingebiel, & Tomasik, 2008) that may influence women's levels of opportunities and aspirations. Empirical findings are mixed, with some studies showing no gender differences in LS (Borg et al., 2008; Fugl-Meyer, Melin, & Fugl-Meyer, 2002) or lower LS in women (Stevenson & Wolfers, 2009) and others finding higher levels of LS in women (Ambrey & Fleming, 2014; Yang, 2008). Education has a significant impact on LS (Inglehart, 2002; Salinas-Jimenez, Artes, & Salinas-Jimenez, 2011), and the effects are slightly higher for women than for men (Salinas-Jimenez, Artes, & Salinas-Jimenez, 2013).

Differences in LS by race/ethnicity are less clear. A study found that Hispanics, who compose the fastest growing segment of the older adult population in the U.S., were more satisfied with their lives than non-Hispanics (Marquine et al., 2015). Another study found that both Blacks and Hispanics had lower LS than Whites (Barger, Donoho, & Wayment, 2009). The U.S. Gallup Poll showed that non-Hispanic Whites had higher LS than Hispanics and non-Hispanic Blacks since 2008, but that Hispanics and non-Hispanic Blacks showed increasing levels in LS in the following 5 years, while non-Hispanic Whites' satisfaction levels remained stable over time ("The Gallup Poll: U.S. Blacks', Hispanics' Life Satisfaction Up From 2008,").

Taken together, our understanding of heterogeneity in LS over the life course by sociodemographic characteristics such as age, education, gender, and race/ethnicity in middle-aged and older Americans is limited and warrants more empirical attention. The majority of previous studies were primarily based on regional and cross-sectional surveys (Diener et al., 1999). Large-scale, population-based longitudinal datasets provide powerful resources to examine longitudinal patterns of LS and to explore the dynamics and causal inferences of subjective quality of life across the life course (George, 2010). Using longitudinal data would allow us to examine if patterns of LS are socially organized by birth cohort, education, gender, race/ethnicity, as well as by the complex interactions among them.

To improve our limited and inconclusive understandings of LS disparities, we utilize five waves of longitudinal data from the U.S. Health and Retirement Study (HRS) over a period of 8 years. We aimed to examine: (1) whether the age-related paradox in LS holds in middle-aged and older Americans, (2) how levels of LS change in older Americans over time by cohort, and (3) whether and how LS varies with education, gender, race/ethnicity, and complex interactions among them. In summary, we conducted a systematic analysis of the influences of social stratifications on LS in middle and late life. Our study may have significant policy implications, as findings can shed light on changes in the social distribution of quality of life in American society by sociodemographic features over time.

2. Method

2.1. Data

Data from HRS were employed to examine the abovementioned research questions. The HRS began collecting health, economic, demographic, and retirement data from a nationally representative sample of individuals over age 50 in 1992 (Sonnega et al., 2014). The HRS is sponsored by the National Institute on Aging (grant number NIA U01AG009740) and

conducted by the University of Michigan. Study participants were interviewed every 2 years, with a random half of the sample assigned to face-to-face interview. The half samples alternate waves, so longitudinal information is available every four years at the individual level. Since 2006 (Sonnega et al., 2014), data collection expanded to include psychosocial context, where half of the sample that completed the core survey is randomly selected to complete the psychosocial questionnaire. As a result, the numbers of repeated measures were not balanced across individuals. In this study, we focused on the 16,163 participants who completed the psychosocial surveys and core surveys in the following five waves: 2006, 2008, 2010, 2012 and 2014. Among the 16,163 participants, approximately 336 (2.1%), 954 (5.9%), 821 (5.1%) and 926 (5.7%) died in 2008, 2010, 2012 and 2014 respectively, and only 260 (1.61%) were lost to follow up.

2.2. Dependent variable

In longitudinal studies, variables include a time variable, time-invariant variables (i.e., subject-level demographics or baseline characteristics), and time-variant variables. The dependent variable is always time-variant. Our dependent variable is the Diener's measure of LS, an established and reliable measure of SWB that is incorporated into the HRS and has been used extensively in international comparative studies of aging (Diener, Emmons, Larsen, & Griffin, 1985; Pavot & Diener, 1993). The index of LS in this analysis is defined as the mean score on a 7-point Likert scale (1 = Strongly disagree, 2 = Somewhat disagree, 3 = Slightly disagree, 4 = Neither agree nor disagree, 5 = Slightly agree, 6 = Somewhat agree and 7 = Strongly agree) across five items. These items include: (a) In most ways my life is close to ideal; (b) The conditions of my life are excellent; (c) I am satisfied with my life; (d) So far, I have gotten the important things I want in life; and (e) If I could live my life again, I would change almost nothing. The LS was measured at each wave, and the internal consistency of this index (assessed by Cronbach's Alpha) was 0.88–0.89 for all waves.

2.3. Independent variables

The time-invariant independent variables are the four 10-year cohorts (50–59, 60–69, 70–79 and 80 or older), gender (male or female), race/ethnicity (African Americans, Hispanics, or non-Hispanic Whites), and educational attainment (< high school, high school/GED, 1–3 years of college, or 4-year college or more). The age cohort was defined by the participants' age at the baseline wave in 2006.

The time-variant control variables are marital status, disabilities in activities of daily living (ADLs), self-rated health, and poverty. Marital transitions can be associated with long-lasting changes in satisfaction, but these changes can be overlooked when only average trends are examined (Lucas, Clark, Georgellis, & Diener, 2003). Marital status was coded into two categories: married or partnered versus alone. Both self-rated health and ADLs are indicators of physical and functional health (Borg et al., 2008; Pinguart, 2001; Sato, Demura, Kobayashi, & Nagasawa, 2002). ADLs were assessed by asking respondents if they had any difficulty in performing tasks, such as bathing, eating, dressing, walking across a room, and getting in or out of bed (yes or no). An index of ADLs was first created by summing the five items (ranging from 0 to 5), and then the index was dichotomized to contrast those without difficulties to those having difficulties with one or more tasks.

Response options for self-rated health were recoded into three categories: excellent or very good, good, and fair or poor. Poverty was defined as yes/no based on regional poverty thresholds defined by the U.S. Census Bureau. Reference groups for the analysis included the baseline wave, the youngest cohort (age 50–59), female, < high school for educational attainment, non-Hispanic White for race/ethnicity, ‘none’ for ADL disability, excellent or very good for self-rated health, “alone” for marital status, and “no” for poverty.

2.4. Statistical analysis

Descriptive statistics (means and standard deviations) were used to summarize LS by wave for all independent variables. One-way ANOVA tests were conducted to examine the heterogeneities of LS for both time-variant and time-invariant variables for each wave. In the next step, random intercept multivariable mixed-effects models were applied to investigate how LS varied by age cohort, gender, race/ethnicity, and educational attainment, adjusting for the time-variant control variables (marital status, ADLs, self-rated health and poverty). The proposed mixed-effects model allowed us to incorporate fixed effects (i.e., the traditional linear model parameter estimates), random variation among respondents, and the unbalanced repeated measures within each respondent (Fitzmaurice, Laird, & Ware, 2004). Technical details of mixed-effects models can be found in Appendix A. We first fitted the main-effect model for all independent variables, and then examined the two-way interaction effects between wave, age cohort, gender, educational attainment and race/ethnicity, while controlling for marital status, ADLs, self-rated health and poverty. Three-way interactions were not considered because of the small sample sizes in some sub-samples. To have a thorough and unbiased understanding of the two-way interaction effects, we performed both stepwise and backward elimination regression analyses with all control variables adjusted in the models. Both methods arrived at the same results. Statistical software R version 3.1.2 was used for data analysis. The R libraries used in the analysis include “nlme” for mixed-effects models, “effects” to predict mean values of LS and to construct 95% confidence intervals (CIs), and “lattice” for the figures.

3. Results

3.1. Sample characteristics

Table 1 shows the sample characteristics for the overall sample of 16,163 participants, and sample characteristics for the following four age cohorts: age 50–59 ($N = 4312$, 26.7%), age 60–79 ($N = 5272$, 32.6%), age 70–79 ($N = 4377$, 27.1%) and age 80 or older ($N = 2202$, 13.6%). There were 9413 (58.2%) females and 6750 (41.8%) males. The majority of the respondents were non-Hispanic White ($N = 12,153$, 75.2%), whereas 1528 (9.5%) were Hispanic, and 2482 (15.4%) were African American. For educational attainment, 3251 (20.1%) did not have a high school degree, 5793 (35.8%) completed high school or the GED, 3698 (22.9%) completed 1–3 years of college, and 3421 (21.2%) completed 4-year of college or higher. About 57.9% of the respondents had been married or partnered over the 8 years, 33.8% had been alone and 8.3% had changes in marital status. Around 82.3% of the sample had no disabilities in ADL during 8 years; and 85.5% had never been under the poverty threshold. For average ratings of physical health, 32.5% of the respondents rated

their average health as excellent or very good, 42.2% rated good, and 25.3% rated fair and poor.

3.2. Bivariate analysis

Means and standard deviations (SD) in LS by independent variables for each wave are shown in Table 2. The numbers of subjects by wave were 7202, 6581, 6419, 5117 and 5504 for 2006, 2008, 2010, 2012 and 2014, respectively. The mean number of repeated measures per participant ranged from one to four, with an average of two. The overall mean LS level was the highest in 2006 (5.13, $SD = 1.52$). It decreased in 2008 (4.93, $SD = 1.53$) and stabled down in 2010 (4.91, $SD = 1.54$) and 2012 (4.84, $SD = 1.53$). In 2014, the overall LS bounced back to 5.04 ($SD = 1.5$). This pattern also was observed within the four age cohorts. The oldest cohort (age 80 +) had the most drastic drop in LS from 2006 to 2008 (from 5.27 to 4.94), and the youngest cohort (age 50–59) had the greatest increase from 2012 to 2014 (from 4.60 to 4.90). In addition, the youngest cohort had the lowest LS level across all waves.

A significant gender difference was only observed at the baseline wave 2006, with a small difference of 0.07 ($p = 0.04$). Education was positively correlated with LS—the differences between highest and lowest education level were between 0.4–0.6 for five waves. African Americans reported the lowest LS for all waves; approximately 0.4–0.5 lower than non-Hispanics Whites and 0.3–0.5 lower than Hispanics. Regarding the control variables, self-rated health was positively correlated with LS, the married/partnered respondents were more satisfied with their lives than those who were alone, and poverty was associated with lower LS. P -values from one-way ANOVA for all waves were below 0.001 except for the gender differences.

3.3. Mixed-model interaction effects

The final mixed-effect model revealed three significant interaction effects: cohort-by-wave ($p = 0.01$), education-by-gender ($p = 0.025$), and education-by-race/ethnicity ($p < 0.001$). To visualize and to interpret the two-way interaction effects, we calculated mean LS levels and respective 95% CIs (Table 3) and graphed the results (Fig. 1). The solid dots in the figures represent mean LS level, and the vertical bands around the solid dots represent the corresponding 95% CIs. If two CIs are farther apart, it implies a statistically significant difference in mean LS levels. Small overlapping confidence bands indicate borderline p -values at the 5% level. We describe each interaction in detail in the following subsections. Parameter estimates and respective confidence intervals from multivariable main-effects model and final interaction models are listed in Appendix B.

3.3.1. Cohort-by-wave interaction—Fig. 1(a) illustrates the cross-sectional differences by age cohort at each wave, as well as the longitudinal trajectory for each age cohort. The figure showed consistently increasing LS with age across all waves, with the most significant difference in 2006. The oldest cohort (age 80+), had the highest levels of mean LS in 2006, the baseline wave (5.45, 95% CI: 5.37–5.53), followed by the three younger cohorts in a descending order: age 70–79 (5.23; 95% CI: 5.17–5.29), age 60–69 (5.03, 95% CI: 4.98–5.09) and age 50–59 (4.72, 95% CI: 4.65–4.78). From 2008 to 2012, the

differences in the three older cohorts shrank, leaving a wider gap between them and the youngest cohort (age 50–59).

Looking at longitudinal trajectories, all cohorts showed a drop in 2008, with the greatest decreases in the oldest (age 80+) and youngest cohort (age 50–59). Decreases in LS became attenuated in 2010, 2012, and finally the LS levels increased in 2014. Looking at LS changes by cohort over the 8 years, the two younger cohorts (age 59–59 and 60–69) had higher LS in 2014 than in 2006, whereas the LS of two older cohorts had not returned or surpassed 2006 LS levels in 2014. Note that members of the oldest cohort were in their late 80 s or 90 s in 2014.

3.3.2. Education-by-gender interactions—In contrast to the bivariate analysis, Fig. 1(b) demonstrates that the highest level of education (4-year college degree or higher) was associated with higher LS for both females (5.18, 95% CI: 5.12–5.24) and males (5.03, 95% CI: 4.97–5.09), approximately 0.2 higher than LS levels for other education groups. In addition, there was a gender crossover of LS at the lower educational levels. For males, the mean scores of LS for those having less than high school education, high school or GED, and 1–3 years of college levels of education decreased from 4.91 and 4.87 to 4.81, before increasing for those with 4 years of college or more. For females, however, increases in LS were seen with increasing education, from 4.89 in those with less than high school, to 4.94 for the next two groups, to 5.18 for those with 4 years of college or more.

Gender differences also were found within educational levels. Although mean LS for females with less than high school were slightly below the LS for males, the mean LS for females was higher than for males by 0.07 (95% CI: 0.01–0.14, $p = 0.03$) in the high school/GED group, 0.13 (95% CI: 0.05–0.21, $p = 0.002$) higher for females than males in the 1–3 years of college group, and 0.15 (95% CI: 0.07–0.23, $p < 0.001$) higher for females than males in the 4+ years of college group.

3.3.3. Education-by-race interactions—As shown in Fig. 1(c), education-related U shapes in LS were found for Hispanics and African Americans. That is, higher levels of LS were observed at the lowest and the highest educational levels. Specifically, for Hispanics, mean LS was 5.40 (95% CI: 5.30–5.49) for those with less than high school education, then decreased for those with high school degree/GED (5.11, 95% CI: 4.98–5.24), decreased further for those with 1–3 years of college (4.94, 95% CI: 4.78–5.091), and then increased for those with 4-year college degrees or higher (5.20, 95% CI: 4.97–5.42). Similarly for African Americans, mean LS was 4.91 (95% CI: 4.82–5.00) for those with less than high school education, decreased to 4.75 and 4.72 for those in the next two education groups, and increased to 4.87 (95% CI: 4.73–5.01) for those with 4-year college degrees or higher. Non-Hispanic Whites demonstrated a linear rather than a U-shaped pattern, with those with less than high school education having the lowest LS (4.85, 95% CI: 4.78–4.91), and those with a 4-year college degree or higher having the highest LS (5.15, 95% CI: 5.11–5.20).

Looking at racial/ethnic differences within each educational level, Hispanics had significantly higher satisfaction than non-Hispanic Whites and African Americans in the two lower education levels. However, no differences were found between Hispanics and non-

Hispanic Whites in the two higher educational levels. In addition, Hispanics had consistently higher LS than African Americans at all educational levels. Note that these patterns were true only after the covariates were statistically controlled, as the bivariate analysis showed higher LS levels in non-Hispanic Whites in comparison with other two groups.

4. Discussion

Employing population-representative longitudinal data over 8 years, this study contributes to the literature by offering evidence of: (1) a significant decrease in LS in 2008 for all age cohorts that lasted until 2012; (2) an age-related paradox of LS in late life; (3) a larger effect of education on LS for females than for males; and (4) the educational paradox in LS among Hispanics and African Americans. These findings are worth in-depth discussion.

The significant decrease in LS in 2008 is likely due to the Great Recession. The Great Recession lasted from December 2007 to June 2009. In 2008 and 2009, the U.S. labor market lost 8.4 million jobs, or 6.1% of all payroll employment ("The state of working America, The Great Recession,"). Together with the bursting of the housing bubble and the drop in the stock market, U.S. family wealth dropped substantially. Our findings suggest that the Great Recession had universal impact on LS for all age cohorts, with the greatest impact on the older workers (age 50–59) and the oldest old (age 80+) in 2008. In October 2010, 16 months after the official end of the recession, the economy still had 5.4% fewer jobs. Loss of wealth could have triggered stress and depression among older Americans who were trying to save money for retirement or were affected by a loss of retirement savings ("Recession on Older Americans' Health and Well-Being,"). The Great Recession had a profound effect on the retirement security of older Americans, and the slow recovery from the downturn will have a lasting impact on their quality of life (Munnell & Rutledge, 2013). Our study showed that the impact lasted from 2008 to 2012.

Second, the statistically adjusted model confirmed the age-related paradox of LS in middle-aged and older adults. Our study shows that LS is positively associated with age for older adults aged 50 years or older, which agrees with the U-shaped happiness-age trajectory with a dip in the age 50 s among affluent countries from the European Social Survey and Australia HILDA Study (Morgan et al., 2015; Segerstrom et al., 2016). In 2014, the LS level for the older cohorts decreased compared to those of 2006, which is also in line with the findings of the second dip in LS in the oldest old from the European Social Survey and Australia HILDA Study (Morgan et al., 2015; Segerstrom et al., 2016). However, it is hard to conclude that the dip in LS in the HRS cohorts was due to the age effect or to the long-term impact from the Great Recession.

Third, we found that females, especially those with higher education, were more satisfied with their lives than males. These findings indicate that education may work effectively to increase individuals' levels of aspiration. Education promotes satisfaction as it improves human capital (Mirowsky & Ross, 2003a) and provides individuals with knowledge and skills that increase earnings and accessibility of goods and services. On the other hand, education also raises aspirations, so it may impact LS in a negative way (Ferrante, 2009). As a result, the net effects of education on LS are likely to depend on the balance between

earned opportunities and increased expectations (Salinas-Jimenez et al., 2011). Our results indicate that education level, especially having a 4-year college degree or more, promotes LS for both men and women, but more so for women. This is in line with the resource substitution theory that education improves women's health more than men's because women have fewer other resources, such as power, authority, and income, on which to rely (Ross & Mirowsky, 2010, 2006). Therefore, the presence of education becomes more critical to promote health and SWB for women. Empirical evidence on physical impairment (Ross & Mirowsky, 2010), self-rated health (Ross, Masters, & Hummer, 2012), and depression (Ross & Mirowsky, 2006) generally substantiates this theory. Also, a recent study using the World Values Survey identified that the direct effects of education on LS are only found for women and not for men (Salinas-Jimenez et al., 2013). In summary, education improves women's life opportunities, and this may lead to a closing gap between aspiration and achievement between men and women.

Lastly, for both Hispanics and African Americans, the relationship between education and LS displayed a U-shaped pattern. This suggests that, for Hispanics and African Americans, gains in aspiration are not catching up with improvements in their socioeconomic opportunities, resulting in the increasing gap between the two that undermines their LS. This is particularly the case for African Americans, for whom a 4-year college degree or higher may not lead to the expected economic returns, making them significantly less satisfied with their lives compared to Hispanics and Whites. Alternatively, it could be that the increased level of LS was offset in African Americans due to their continued experiences of race-based micro-aggressions and discrimination. For example, a 2015 review of 293 studies on racism and health found that perceived racism was associated with poorer mental and physical health, and that age, sex, birthplace, and education level did not moderate the effects of racism on health (Paradies et al., 2015).

In addition, bivariate analysis showed that Hispanics shared comparable levels of LS with Whites. While adjusting for all covariates in the multivariate analysis, Hispanics had the highest LS despite their disadvantaged socioeconomic status on average. Hispanics with high school or lower levels of education even reported higher levels of LS than their White counterparts, and this is consistent with several previous studies (Calvo, Carr, & Matz-Costa, 2016; Marquine et al., 2015). This finding might be explained in part by the "Hispanic Paradox," referring to the fact that Hispanic immigrants have lower mortality rates and longer life expectancies than non-Hispanic Whites, despite lower average income and education (Abraido-Lanza, Dohrenwend, Ng-Mak, & Turner, 1999; Hummer & Hayward, 2015; Markides & Coreil, 1986; Markides & Eschbach, 2011). Among the HRS Hispanics, 51.2% were foreign-born, compared to only 4.2% of Whites and 6.0% of African Americans. Although empirical assessment of factors contributing to the "Hispanic Paradox" is still limited, culture-related factors may be the most relevant ones to consider, as quality of life is a value-laden and culturally dependent construct (Iwasaki, 2007; WHO, 1997). Religious practice and spiritual experiences, for instance, are found to be associated with SWB (Ellison, 1991), and thus may play important roles in explaining the "Hispanic Paradox" in LS (Marquine et al., 2015). In the HRS, about 96% of Hispanics were religious comparing to 92% of Whites and 95% of African Americans. Unfortunately, we do not have

data on service attendance. We conducted sensitivity analyses by including variables on religiosity and nativity in the final model, and the results remained the same.

5. Limitations

Several limitations need to be addressed. First, we did not find any significant interactions between cohort and gender or education. So we are unable to conclude if gender or educational disparities in LS increase or decrease by cohort. In addition, the “Hispanic Paradox” in LS deserves future research that considers immigration-related factors such as nativity, country of origin, and English-language proficiency. Domain-specific satisfaction was not examined in this study due to lack of data in the HRS. Moreover, the repeated measures were only available at the individual level over a span of 8 years. Longer period and more frequent follow-ups would provide better insights into the causal relationships in LS. The sample sizes were small for Hispanics and African Americans in the older age groups, and other minority racial/ethnic groups (i.e., Asian Americans, American Indians and Alaska Native, and Native Hawaiians and other Pacific Islanders) were excluded from the analysis because of sample sizes for these groups were extremely small. Furthermore, survey weights were not used in the analysis because of the practical limitations in multi-level modeling or modeling effects of interactions (Gelman, 2007). Still, unweighted regression models provide unbiased estimates of standard errors (Gelman, 2007; Radbill, 1994). Lastly, there was attrition of respondents particularly in the oldest cohorts in the 2014 HRS wave. This could have biased results, as the observed 80+ cohort could have been more robust than those who did not survive to the 2014 wave.

6. Public health implications

Under the context of increasing population aging in the U.S., it is important to examine if Americans live better lives, as well as longer lives. Focusing on older adults, this study examined cohort variations in LS over the life course as well as subgroup variations in SWB, a popularly used social indicator of quality of life within a population (George, 2010). Our findings provide longitudinal evidence revealing that not all social groups are equally satisfied with their lives. The older cohorts, individuals with the highest levels of education, and Hispanics reported higher LS than the others did. The racial/ethnic differences in the impact of education suggest that the economic and health returns of education are likely to be divergent for different social groups. Researchers should continue to examine reasons for these disparities. Policy makers should attend to these findings so that interventions to reduce disparities in LS in old age, and across the life course, can be supported and broadly implemented.

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Abbreviations

LS	life satisfaction
SWB	subjective well-being
ADL	activities of daily living

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Appendix A. Introduction to mixed-effects models

Let y_i denotes the i th of N independent subjects in a dataset, below is the traditional linear model formula:

$$y_i = X_i \beta + \varepsilon_i, \quad i = 1, \dots, N,$$

$$\varepsilon_i \sim N(0, \sigma_\varepsilon^2),$$

where β is a vector of the parameters for independent variables X and σ_ε^2 is the variance of error terms ε_i .

For this longitudinal study, we can use $y_{ij} = (y_{i1}, y_{i2}, y_{i3}, y_{i4}, y_{i5})$ to denote the five life satisfaction measurements ($j = 1, \dots, 5$) for the i th individual. Then subject i 's life satisfaction at time j can be expressed in the linear mixed-effects model framework as:

$$Y_{ij} = X_{ij}\beta + b_i + \varepsilon_{ij}, \quad i = 1, \dots, N,$$

$$b_i \sim N(0, \sigma_b^2), \varepsilon_{ij} \sim N(0, \sigma_\varepsilon^2),$$

where β is a vector of fixed effects (same as β the in the linear model) and b_i is a vector of random intercepts N individuals. The parameter, σ_b^2 measures the within subject variation of life satisfaction.

Appendix B. Parameter estimates and 95% CIs from mixed-effects models

	Main Effects Model		Interaction Model	
	Estimate	95%CI	Estimate	95%CI
Intercept	4.93	(4.85, 5.01)***	4.76	(4.66, 4.87)***
Wave				
2008	-0.16	(-0.21, -0.12)***	-0.19	(-0.28, -0.09)***
2010	-0.17	(-0.21, -0.14)***	-0.15	(-0.22, -0.07)***
2012	-0.23	(-0.28, -0.18)***	-0.21	(-0.31, -0.12)***
2014	0.03	(-0.01, 0.07)	0.11	(0.04, 0.19)**
Age cohort				
60–69	0.34	(0.29, 0.39)***	0.32	(0.23, 0.41)***
70–79	0.48	(0.43, 0.53)***	0.52	(0.43, 0.61)***
80+	0.64	(0.58, 0.71)***	0.73	(0.63, 0.84)***
Gender				
Male	-0.09	(-0.13, -0.05)***	0.02	(-0.07, 0.11)
Education				
HS/GED	-0.05	(-0.11, 0.01)	0.11	(0.03, 0.20)**
College 1–3y	-0.07	(-0.13, -0.01)*	0.13	(0.04, 0.22)**
College 4y+	0.17	(0.10, 0.23)***	0.38	(0.28, 0.47)***
Race/Ethnicity				
Hispanic	0.28	(0.21, 0.36)***	0.55	(0.44, 0.66)***
African American	-0.13	(-0.19, -0.08)***	0.06	(-0.04, 0.17)
Number of ADL				
1+	-0.43	(-0.47, -0.38)***	-0.42	(-0.47, -0.38)***
Self-rated Health				
Good	-0.33	(-0.36, -0.29)***	-0.32	(-0.36, -0.29)***
Fair/poor	-0.88	(-0.93, -0.84)***	-0.88	(-0.93, -0.84)***
Marital Status				
Married or Partnered	0.41	(0.37, 0.45)***	0.41	(0.37, 0.45)***
Under Poverty				
Yes	-0.05	(-0.10, 0.01)	-0.06	(-0.11, 0.00)*

	Main Effects Model		Interaction Model	
	Estimate	95%CI	Estimate	95%CI
Intercept	4.93	(4.85, 5.01)***	4.76	(4.66, 4.87)***
Wave * Age cohort				
2008:Age 60–69			0.09	(–0.04, 0.21)
2010:Age 60–69			0.03	(–0.07, 0.13)
2012:Age 60–69			0.04	(–0.09, 0.17)
2014:Age 60–69			–0.06	(–0.16, 0.04)
2008:Age 70–79			0.04	(–0.09, 0.17)
2010:Age 70–79			–0.07	(–0.17, 0.03)
2012:Age 70–79			–0.02	(–0.16, 0.11)
2014:Age 70–79			–0.18	(–0.29, –0.07)***
2008:Age 80+			–0.08	(–0.24, 0.07)
2010:Age 80+			–0.13	(–0.26, 0.00)*
2012:Age 80+			–0.09	(–0.27, 0.09)
2014:Age 80+			–0.22	(–0.38, –0.06)**
Gender * Education				
Male * HS/GED			–0.10	(–0.21, 0.01)
Male * College 1–3y			–0.15	(–0.27, –0.03)*
Male * College 4y			–0.17	(–0.29, –0.05)**
Edu * race				
HS/GED * Hispanic			–0.36	(–0.53, –0.19)***
College 1–3y * Hispanic			–0.52	(–0.72, –0.33)***
College 4y * Hispanic			–0.51	(–0.76, –0.26)***
HS/GED * African American			–0.24	(–0.38, –0.09)**
College 1–3y * African American			–0.25	(–0.40, –0.09)**
College 4y * African American			–0.34	(–0.52, –0.17)***
* $P < 0.05$.				
** $P < 0.01$.				
*** $P < 0.001$.

Fig. 1.

(a) Cohort-by-race, and (b) Education-by-gender and (b) education-by-race interaction. The model predicted mean life satisfaction levels and 95% CIs are represented by dots and vertical bands. If two confidence bands are further apart, the p -values for the difference is < 0.01 , if two confidence bands have a small overlapping band, the p -values is around 0.05.

Cohort characteristics. Descriptive statistics mean (SD) were used to summarize continuous variable age, and frequencies and percentages, n (%) were calculated for categorical variables. Time variant variables: marital status, ADLs, self-rated health and poverty threshold were summarized on subject level.

Table 1

	Overall	50–59	60–69	70–79	80+
	N = 16163	4312(26.7%)	5272(32.6%)	4377(27.1%)	2202(13.6%)
	N(%)	N(%)	N(%)	N(%)	N(%)
Gender					
Female	9413(58.2%)	2598(60.3%)	3027(57.4%)	2442(55.8%)	1346(61.1%)
Male	6750(41.8%)	1714(39.7%)	2245(42.6%)	1935(44.2%)	856(38.9%)
Race/Ethnicity					
Non-Hispanic White	12,153(75.2%)	2768(64.2%)	3994(75.8%)	3511(80.2%)	1880(85.4%)
Hispanic	1528(9.5%)	623(14.4%)	496(9.4%)	285(6.5%)	124(5.6%)
African American	2482(15.4%)	921(21.4%)	782(14.8%)	581(13.3%)	198(9.0%)
Education					
< HS	3251(20.1%)	565(13.1%)	1048(19.9%)	1008(23.0%)	630(28.6%)
HS/GED	5793(35.8%)	1344(31.2%)	1980(37.6%)	1723(39.4%)	746(33.9%)
College 1–3y	3698(22.9%)	1255(29.1%)	1162(22.0%)	821(18.8%)	460(20.9%)
College 4y+	3421(21.2%)	1148(26.6%)	1082(20.5%)	825(18.8%)	366(16.6%)
Marital Status					
Married/partner	9353(57.9%)	2806(65.1%)	3393(64.4%)	2391(54.6%)	763(34.7%)
Other	5464(33.8%)	1179(27.3%)	1405(26.7%)	1595(36.4%)	1285(58.4%)
Status change	1346(8.3%)	327(7.6%)	474(9.0%)	391(8.9%)	154(7.0%)
Mean ADLs					
None	13306(82.3%)	3732(86.5%)	4577(86.8%)	3542(80.9%)	1455(66.1%)
1	1342(8.3%)	304(7.1%)	331(6.3%)	394(9.0%)	313(14.2%)
2	879(5.4%)	162(3.8%)	237(4.5%)	264(6.0%)	216(9.8%)
3	291(1.8%)	50(1.2%)	65(1.2%)	78(1.8%)	98(4.5%)
4	219(1.4%)	42(1.0%)	46(0.9%)	62(1.4%)	69(3.1%)
5	126(0.8%)	22(0.5%)	16(0.3%)	37(0.8%)	51(2.3%)
Mean Self-rated Health					

	Overall	50–59	60–69	70–79	80+
	N (%)	N (%)	N (%)	N (%)	N (%)
Excellent/very good	5254(32.5%)	1668(38.7%)	1840(34.9%)	1225(28.0%)	521(23.7%)
Good	6821(42.2%)	1638(38.0%)	2248(42.6%)	1981(45.3%)	954(43.3%)
Fair/poor	4088(25.3%)	1006(23.3%)	1184(22.5%)	1171(26.8%)	727(33.0%)
Under Poverty threshold					
Never	13,817(85.5%)	3512(81.4%)	4593(87.1%)	3793(86.7%)	1919(87.1%)
Ever, always	2346(14.5%)	800(18.6%)	679(12.9%)	584(13.3%)	283(12.9%)

Table 2

Mean (SD) of life satisfaction levels by wave for all variables. One-way ANOVA tests of homogeneity of life satisfaction were conducted for all independent variables for each wave. All p -values were below 0.001 except for gender differences. Gender differences were only marginally significant at wave 2006 ($p = 0.04$).

Wave	2006	2008	2010	2012	2014
Sample Size by wave	N = 7202	N = 6581	N = 6419	N = 5117	N = 5504
Overall Mean (SD)	5.13(1.52)	4.93(1.53)	4.91(1.54)	4.84(1.53)	5.04(1.50)
	Mean(SD)	Mean(SD)	Mean(SD)	Mean(SD)	Mean(SD)
Age cohort					
50–59	4.87(1.61)	4.65(1.64)	4.68(1.63)	4.60(1.61)	4.90(1.55)
60–69	5.13(1.52)	5.01(1.50)	5.02(1.52)	4.94(1.47)	5.13(1.48)
70–79	5.25(1.48)	5.04(1.46)	5.02(1.46)	4.94(1.50)	5.08(1.46)
80+	5.27(1.43)	4.94(1.48)	4.94(1.48)	4.92(1.48)	5.10(1.36)
Gender					
Female	5.10(1.56)	4.90(1.57)	4.89(1.56)	4.81(1.55)	5.03(1.50)
Male	5.17(1.47)	4.97(1.47)	4.94(1.51)	4.87(1.49)	5.06(1.49)
Race/Ethnicity					
Non-Hispanic White	5.19(1.50)	5.00(1.52)	5.00(1.51)	4.92(1.52)	5.12(1.47)
Hispanic	5.16(1.57)	4.85(1.54)	4.92(1.61)	4.67(1.54)	5.06(1.56)
African American	4.71(1.57)	4.54(1.52)	4.41(1.56)	4.48(1.52)	4.62(1.50)
Education					
< HS	4.96(1.59)	4.68(1.54)	4.73(1.59)	4.56(1.56)	4.89(1.54)
HS/GED	5.07(1.52)	4.89(1.52)	4.86(1.53)	4.75(1.55)	4.97(1.51)
College 1–3y	5.10(1.50)	4.91(1.56)	4.77(1.55)	4.84(1.51)	4.95(1.50)
College 4y+	5.40(1.45)	5.27(1.44)	5.27(1.44)	5.18(1.43)	5.35(1.38)
Marital Status					
Alone	4.77(1.62)	4.56(1.56)	4.53(1.61)	4.51(1.55)	4.80(1.53)
Married or Partnered	5.30(1.44)	5.14(1.47)	5.13(1.46)	5.03(1.48)	5.21(1.45)
Number of ADL					
None	5.25(1.46)	5.08(1.46)	5.06(1.48)	4.99(1.46)	5.20(1.43)
1+	4.45(1.67)	4.14(1.61)	4.17(1.62)	4.07(1.61)	4.30(1.56)

Wave	2006	2008	2010	2012	2014
Sample Size by wave	N = 7202	N = 6581	N = 6419	N = 5117	N = 5504
Overall Mean (SD)	5.13(1.52)	4.93(1.53)	4.91(1.54)	4.84(1.53)	5.04(1.50)
	Mean(SD)	Mean(SD)	Mean(SD)	Mean(SD)	Mean(SD)
Self-rated Health					
Excellent/very good	5.52(1.36)	5.46(1.35)	5.45(1.35)	5.38(1.33)	5.53(1.33)
Good	5.15(1.45)	4.96(1.40)	4.88(1.44)	4.82(1.39)	5.09(1.36)
Fair/poor	4.49(1.63)	4.18(1.58)	4.10(1.59)	3.98(1.60)	4.30(1.58)
Under Poverty					
No	5.19(1.48)	4.99(1.50)	4.96(1.51)	4.89(1.51)	5.10(1.47)
Yes	4.40(1.78)	4.30(1.64)	4.40(1.71)	4.45(1.61)	4.65(1.61)

Table 3

Estimated means and 95% CIs from each interaction effect from the mixed-effect model. These means and 95% CIs are graphed in Fig. 1 for a clear visualization.

Cohort-by-wave interaction				
	50–59	60–69	70–79	80+
2006	4.72(4.65–4.78)	5.03(4.98–5.09)	5.23(5.17–5.29)	5.45(5.37–5.53)
2008	4.53(4.46–4.60)	4.94(4.88–4.99)	5.09(5.02–5.15)	5.18(5.09–5.27)
2010	4.57(4.51–4.63)	4.92(4.86–4.98)	5.02(4.95–5.08)	5.17(5.07–5.27)
2012	4.50(4.43–4.57)	4.86(4.80–4.92)	4.99(4.92–5.07)	5.15(5.01–5.28)
2014	4.83(4.77–4.89)	5.09(5.03–5.15)	5.17(5.09–5.24)	5.34(5.21–5.48)
	< HS	HS/GED	College 1–3y	College 4y+
Education-by-gender interaction				
Female	4.89(4.83–4.95)	4.94(4.90–4.98)	4.94(4.89–4.99)	5.18(5.12–5.24)
Male	4.91(4.84–4.98)	4.87(4.82–4.92)	4.81(4.75–4.87)	5.03(4.97–5.09)
Education-by-race interaction				
Hispanic	5.40(5.30–5.49)	5.11(4.98–5.24)	4.94(4.78–5.09)	5.20(4.97–5.42)
Non-Hisp.White	4.85(4.78–4.91)	4.92(4.88–4.95)	4.91(4.86–4.95)	5.15(5.11–5.20)
African American	4.91(4.82–5.00)	4.75(4.66–4.83)	4.72(4.62–4.83)	4.87(4.73–5.01)