Life course social connectedness : age-cohort trends in social participation

Ang, Shannon

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TITLE

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ABSTRACT

Social connectedness has emerged in recent decades as a key determinant of well-being.

Considering its importance, several studies have sought to describe how overall trends in society have changed over the years, while others have been more concerned with how it changes as individuals age. This study set out to synthesize these two strands of research by describing age-cohort trends of social connectedness, using social participation as the key indicator. Data are from the Americans' Changing Lives survey, a nationally representative panel dataset with an accelerated longitudinal design, collected over 25 years. Multivariate Bayesian generalized additive mixed models (GAMMs) were utilized to estimate age-cohort trajectories of formal and informal social participation. Findings show that even as informal social participation decreases with age, formal social participation increases – suggesting some form of compensatory mechanism. Further, while informal social participation remains stable across cohorts, formal social participation increases in later cohorts. These results suggest that the isolation of old age or overall societal declines in social participation in America may be overestimated by some observers, but more research is needed to more comprehensively describe how other aspects of social connectedness are distributed over the life course.

KEYWORDS

Social connectedness; cohort change; social participation; age trajectory

INTRODUCTION

Social connectedness has quickly gained traction as an important research area in the past two decades, with much evidence pointing to its considerable impact on various outcomes for both individual and society. Researchers have consistently found that higher levels of social connectedness are linked to desirable outcomes such as increased political participation (Paxton 2002, Reilly 2017), and better health outcomes (Cornwell and Waite 2009, Kawachi, Subramanian and Kim 2008). On the other hand, a lack of social connectedness (i.e., social isolation) often leads to increased mortality risk (Holt-Lunstad et al. 2015), and can exacerbate the negative consequences from natural disasters (e.g., a heat wave, Klinenberg 2001).

Findings suggesting the decline of social connectedness in American society have thus led to some public anxiety. Sociologists Robert Putnam and Claude Fischer have been the two main contributors to (rather public) debates on this issue. Putnam (2000) first argued in *Bowling Alone* that the proportion of people engaging in regular group activities and informal social gatherings was sharply decreasing. This, he claimed, signalled the fragmentation of society that would eventually lead to the erosion of democracy, economic productivity, and general well-being of its citizens. Many commentators then offered reasons for this apparent decline, ranging from industrialization, capitalism, to feminism (for a review, see Wellman 2001). By contrast, Fischer (2011) assembled new evidence in *Still Together* to demonstrate that Americans remain as socially connected as before – particularly in areas of informal social participation such as making phone calls, and/or having meals with family and friends. Given these trends, it was concluded, the “panic” around social connectivity was unfounded (Wang and Wellman 2010).

Americans' ties to their family and friends remained stable, resilient to wider changes in society such as technological advances and demographic shifts (Fischer 2011).

Yet despite the vast attention placed on the decline and/or continuity of social connectedness in society, the current literature has not managed to fully address one crucial question - are these patterns (whether decline or continuity) primarily a result of the rapidly changing population age composition, or of cohort changes in other areas (e.g., culture, marriage/employment patterns)? These are crucial tenets in the arguments being made, but because these earlier investigations relied mainly on repeated cross-sectional data from a variety of sources, scholars encountered two main difficulties. First, as Fischer (2011:49) explicitly notes, age and cohort effects could not be directly separated. While Putnam (2000) attempted to approximate cohort effects by comparing rates from similar age groups across different survey years, it is unclear whether the trends derived from these synthetic cohorts (i.e., containing different cohort members at each time point) are able to sufficiently mimic true cohort patterns. Second, although changing life course circumstances between cohorts (e.g., delay of marriages, fewer children, more people living alone in later cohorts) were offered as plausible explanations for the purported trends in social connectedness, these studies could not directly estimate the impact of these factors on cohort differences within a single statistical model. Rather, they were forced to make extrapolations based on observational trends pieced together from synthetic cohorts.

To address these shortcomings in prior research, I use nationally representative panel data collected over 25 years to examine how the frequency of participation in formal and informal social activities change simultaneously by age and by cohort. Based on these indicators of social

connectedness, I find that even as informal social participation decreases with age, formal social participation increases – suggesting some form of compensatory mechanism. Also, I find that while informal social participation remains stable across cohorts, formal social participation increases in cohorts born more recently, contrary to what Putnam (2000) suggests.

THEORETICAL BACKGROUND

Social connectedness is a general term broadly encompassing the quantity, quality, frequency, type and network structure of one's relationships with friends, family, and the community. Being socially connected depends on one's relationships with close friends and family, as well as broader aspects of social life such as participation in social activities organized by clubs and associations. It is accepted that these aspects of social connectedness change over time, owing to shifts in individual life circumstances (age effects) and generational differences (cohort effects). These pertain to life course principles of *life-span development* and *historical time and place* respectively (Elder 1998). First, the life course perspective extends social inquiry across the whole life span, arguing that later life outcomes should thus always be seen in the context of one's earlier life. Sociologists have long acknowledged that societies often formally and informally structure individual roles and statuses according to age (Riley 1987). Expectations and circumstances surrounding any individual are subject to change across the life course because formal social institutions of education, work, and family are usually built around age; attitudes, stereotypes and beliefs about appropriate behaviour are shaped around perceived age boundaries (Chudacoff 1992). The existence of these social norms and expectations structure age trajectories to produce an extent of regularity between individuals, enabling the study of 'age effects'. The life course perspective also acknowledges cohort effects (i.e., the influence of

historical time and place) – since persons born within a similar time period (i.e., a birth cohort) are exposed to similar historical circumstances and/or events as they move through the life course, they are likely to share certain characteristics (or life histories) as a group. For instance, the Civil Rights Movement opened up access to education for younger cohorts of African Americans, unlike for older cohorts where such opportunities were scarce (Jackson 1993). These shared circumstances can then affect their subsequent life trajectories, often leading to cohort differences (or ‘generational differences’) across various outcomes. Social connectedness over the life course can therefore be understood as a function of both age and cohort, even though scholars tend disagree on exactly *how* these factors affect overall societal social connectedness.

AGE AND SOCIAL CONNECTEDNESS

Existing social theory concerning age trajectories of social connectedness have focused heavily on late-life circumstances, attempting to describe the aging process. Disengagement theory expects that older adults will gradually and permanently retreat from their social involvements as they age and approach the time of their deaths (Cumming and Henry 1961). It was argued that older adults should desire and come to accept this normative process of disengagement, in order to make room for younger generations within the social structure. Both activity (Havighurst 1961) and continuity (Atchley 1989) theories emerged to oppose this view, arguing that disengagement was in fact pathological – older adults should instead seek to maintain or increase their social participation despite various changes in later life such as retirement or widowhood. These alternate viewpoints are well encapsulated by Simmons (1952:45), who argued earlier that “the secret of success for anyone facing a long life...is to find for himself a suitable place in his society in which to age with grace and usefulness, and to participate tactfully and fully up to the

very end if at all possible.” While many researchers and policymakers have opted to use these positive approaches in aging discourse (Johnson and Mutchler 2014), some empirical work has found that social activity declines with age – that is, older people are less likely to participate in social activities (Marcum 2013, Pinto and Neri 2017). As alluded to above, however, these studies usually focus on older adults, and do not provide us a view of connectedness over the entire adult life course. Consequently, we are unable to validate these theories of aging, since there is no empirical contextualization of later life patterns in social connectedness vis-à-vis those of young adulthood (e.g., is it possible that older adults are actually more connected than young adults are?).

COHORT AND SOCIAL CONNECTEDNESS

Arguments around the decline (or continuity) of connectedness in American society are intricately linked to cohort change. Putnam (2000:257) claims that the primary driver of social decline is cohort (or ‘generational’) difference, pointing to the existence of “a long civic generation, born roughly between 1910 and 1940, a broad group of people substantially more engaged in community affairs and more trusting than those younger than they”. He argues that cohorts born after this “long civic generation” have been less and less engaged with the community, concluding that overall connectedness is likely to decrease as younger cohorts replace older ones. On the other hand, Fischer (2011) posits that while later cohorts may exhibit different patterns in their social behavior (i.e., less dinner parties and more electronic communication), social connectedness with friends and family remained largely the same across all other dimensions (i.e., satisfaction with friendships, frequency of contact). Both Putnam (2000) and Fischer (2011) acknowledge that at least part of this cohort change may be due to

demographic shifts in areas such as education, marriage, and parenthood. For instance, if married people are more likely to engage in community organizations, then a decreasing prevalence of marriage in younger cohorts would mean that such engagement would also decrease over time. Neither study, however, was able to directly estimate how these changes affect cohort trends, often relying on broad associations to speculate about their explanatory power.

THE PRESENT STUDY

Because social connectedness is a broad and multidimensional concept that has been conceptualized and operationalized in various ways, it is exceedingly difficult to meaningfully address all of these various aspects at once (even Putnam and Fischer's book-length treatments of the matter cannot claim to be exhaustive). In this study, I focus on one of its most important dimensions (i.e., social participation) to tease out age-cohort patterns, and allow the findings to provide an empirical springboard for future research to investigate whether results hold across other aspects of social connectedness. The specific objectives/scope of this study are delineated below, followed by elaboration on the specific means through they are addressed.

RESEARCH OBJECTIVES

The primary aim of this study is to describe patterns in social connectedness over a substantial period of time, so as to disentangle age and cohort effects. The second aim of this study is to look at how demographic patterns (e.g., trends in marriage, parenthood, employment) affect age and cohort trends. To do this, I avoid the attempt to paint a broad picture of social connectedness across all its numerous dimensions (e.g., network size, perceived support, closeness, conflict) for a narrow age group (i.e., taking the 'wide' approach, as Cornwell, Laumann and Schumm (2008)

have done), and instead focus on one key constituent of social connectedness to describe how it is distributed over the adult life course and across cohorts (i.e., taking the ‘long’ approach). This integral component of connectedness is *social participation*, on which both Putnam (2000) and Fischer (2011) have relied heavily on despite making wider arguments about social connectedness in general.

SOCIAL PARTICIPATION AS A MEASURE OF SOCIAL CONNECTEDNESS

Two distinct but related aspects of social participation are thought to constitute a fundamental part of our social connectedness¹: formal social participation (e.g., attendance and engagement in community groups and organizations), and informal social participation (e.g., contact and activities with friends and family) (Levasseur et al. 2010, Teele 1962, van Ingen 2008). Each type of social participation is associated with different facets of social connectedness and well-being. For instance, while formal social participation strengthens one’s social identity that is derived from group membership, informal social participation is thought to promote social support from close network members and may reduce one’s feelings of loneliness (Berkman et al. 2000, Cornwell, Laumann and Schumm 2008, Levasseur et al. 2010).

Several factors make the proposed measure of social participation ideal for examining long run changes in social connectedness. First, while network measures of social connectedness (e.g., naming the friends/family you have “discussed important matters” with) have gained tremendous popularity over the past decade, responses to this type of question are rather volatile. Researchers have found that they are often susceptible to interviewer effects (Fischer 2009) and are prone to large fluctuations over short periods of time (Small, Deeds Pamphile and McMahan 2015). It is

for this reason that previous findings showing decreasing social connectedness in the United States based on the General Social Survey (McPherson, Smith-Lovin and Brashears 2006) have been hotly contested by others (Fischer 2009, Paik and Sanchagrin 2013) who conclude that this finding was an artifact caused by interviewer differences. By contrast, measures of social participation tend to remain relatively stable over short to medium periods of time with good test-retest reliability (Bukov, Maas and Lampert 2002, Hyypä et al. 2008, Stansfeld and Marmot 1992). Second, established theories of aging such as the socioemotional selectivity theory (Carstensen 1992) and the convoy model of social relationships (Kahn and Antonucci 1980) expect that older adults change the composition of their personal social networks as they age. While older adults tend to decrease the *number* of relationships they have in later life, they then turn toward improving the quality of their remaining relationships. Changes in these indicators thus cannot be easily interpreted as changes in overall social connectedness without a more comprehensive understanding of the context. Unfortunately, longitudinal panel data on other aspects of social connectedness are scarce. On the other hand, *the frequency of social contact* is often a pre-requisite for the maintenance of meaningful relationships, regardless of location in the life course. It has also been found to be, for the most part, as important for the physical and mental well-being of younger adults as it is for those who are older (Ang 2018). Along with the availability of panel data on social participation, we are able to estimate and make direct comparisons across age and cohort.

DATA AND METHOD

Data are from the American's Changing Lives (ACL) survey (House, Lantz and Herd 2005), a nationally representative, prospective panel study. The ACL uses an accelerated longitudinal

design – this means that it interviews adults from a wide range of ages (and therefore multiple birth cohorts) and re-interviews them over time to examine age and cohort differences (see Galbraith, Bowden and Mander 2014). Baseline interviews were conducted in 1986, with follow-up interviews conducted in 1989, 1994, 2002, and 2011. At Wave 1, a multistage stratified area probability sample of the United States population aged 25 and above was interviewed face-to-face. African Americans and those over the age of 60 were oversampled by a factor of two. The current analysis uses data from all five waves of the study where information for all variables are available, resulting in 11755 person-year observations (N = 3,603 in 1986; N = 2860 in 1989; N = 2373 in 1994; N = 1601 in 2001; and N = 1318 in 2011). Each person interviewed in the first wave may contribute anywhere between one to five waves of data in this analysis, depending on whether and when attrition or mortality occurred. Weights accounting for complex survey design were incorporated in all analyses.

DEPENDENT VARIABLES

The measures for social participation here are derived from work in Veroff, Kulka and Douvan (1981). The measure for formal social participation is a standardized index based on responses to two questions: (a) “how often do you attend meetings or programs of groups, clubs, or organizations that you belong to?” and (b) “how often do you usually attend religious services?” Informal social participation is a standardized index based on another set of questions: (c) “How often do you get together with friends, neighbours, or relatives and do things like go out together or visit in each other’s homes?” and (d) “In a typical week, about how many times do you talk on the telephone² with friends, neighbours, or relatives?” Response categories for questions (a), (b), and (d) were: (1) more than once a week; (2) once a week; (3) two or three times a month; (4)

about once a month; (5) less than once a month; and (6) never. Response categories for question (c) were: (1) more than once a day; (2) once a day; (3) two or three times a week; (4) about once a week; (5) less than once a week; and (6) never or no phone. These response categories were reverse-coded so that a higher number reflected greater social participation.

To further validate the division of items into scales of formal and informal social participation (in line with what has been suggested in past studies), I performed Mokken scale analyses to check if the items could be put together in a single scale for ease of interpretation. Mokken scale analysis is a non-parametric item response theory method suitable for scales with few items (van Schuur 2003). The items scaled onto two latent factors as expected, with the first two items forming one scale, and the latter two forming another (Loevinger's H coefficient > 0.3). To construct the final indexes, the mean of items within each scale were computed and then standardized (i.e. rescaled to have a mean of zero and variance of one) based on the weighted mean and standard deviation at Wave 1. As part of sensitivity analyses, models predicting each individual item (i.e., attend meetings, attend religious services, get together, talk on the phone) separately were estimated – differences in the trajectories were small and general patterns are well represented by the 'pooled' models here using overall indexes.

KEY INDEPENDENT VARIABLES

Age across all person-year observations ranged from 25-95+ (those aged older than 95 were top-coded [recoded to 95] due to a limited number of observations in that age range). Following Clarke et al. (2011), respondents were grouped into six ten-year birth cohorts (born 1911 or earlier, 1912-21, 1922-31, 1932-41, 1942-51, and 1952-61).

COVARIATES

Sociodemographic variables used in the analysis were gender (men, women), race (non-Hispanic white, non-Hispanic African American, other races), education (less than high school, high school diploma, college degree or higher), and inflation-adjusted annual household income in 1986 dollars for the last 12 months (Less than \$10,000, \$10,000-29,999, \$30,000 and above). Further, to examine how age-cohort trends are affected by changes in life course events such as marriage and employment (e.g., does social participation increase/decrease in later cohorts due to lower rates of marriage?), I include several covariates and compare trends from the adjusted model to the non-adjusted model. Variables denoting marital status (married, separated/divorced, widowed, never married) and employment (employed, unemployed, retired, homemaker) were also added. A dichotomous variable indicating whether the respondent had a child under 17 living in the same household was used to assess the presence of parental responsibilities. To account for lack of social participation due to the presence of physical limitations (or disability), a dichotomous measure of functional limitations captured whether the respondent reported difficulty in at least one of the following activities: bathing, climbing a few flights of stairs, walking several blocks, and doing heavy work around the house (such as shovelling snow or washing walls). All covariates except for race and education were time-varying (i.e., within person response may or may not change in each wave).

ANALYTICAL STRATEGY

Bayesian generalized additive mixed models (GAMMs) - a semi-parametric modelling strategy allowing for a combination of parametric and non-parametric smooth terms to model nonlinear

trajectories - were utilized to estimate age-cohort trajectories of formal and informal social participation. Executed using the multilevel framework (therefore ‘mixed models’), these models account for within-person clustering and adjust for unbalanced designs (Raudenbush and Chan 1992) where each individual may contribute a different number of observations (i.e. partially missing data). The ability of such models to recover age and cohort effects is based on age overlaps in the data, and are frequently used in past research (even though these studies mostly address it within the frequentist framework) (Galbraith, Bowden and Mander 2014, Yang 2011). The analysis is weighted (using time varying weights) to account for sample design at each wave and is representative of the population ages 25 years and above living in the United States in 1986. Further, dummy variables for death and non-response (a time invariant indicator for those who died or did not respond to one or more waves) and their interactions with the age trajectory were used to account for attrition, following prior research using a similar modelling strategy in the parametric multilevel regression framework (Boen 2016, Yang and Lee 2009). As a check for robustness, a number of different alternate cohort specifications were tested (e.g. five-year age cohorts), but there was no substantial change to the findings.

A two-level model was used for this analysis, with repeated measurements across survey waves (level one) nested within individuals (level two). Group-level effects were estimated for the intercept and age effect to allow for heterogeneity between individual trajectories in their starting point and slope. The main advantage of using a GAMM is that it avoids the need for a priori assumptions about the shape of trajectories (i.e., quadratic, cubic etc.), which would otherwise have been problematic since the shape of both age and cohort are highly interdependent. GAMMs provides flexibility in the estimating the trajectory’s shape, using Restricted Maximum

Likelihood (REML) to determine the smoothing function $f(x)$ that best fits the data. These non-parametric smooth functions also help prevent inference from being overly influenced by regions where there is less data (Gupta and Ash 2008) – in this case, those observed at extreme points on the age spectrum, as well as those born in the earliest cohorts. The bivariate tensor product spline accounts for the different scales of the two variables (here they are age and cohort) and allows for simultaneous smoothing over both dimensions (thus accounting for their interactions). I use this approach to model age-cohort trajectories simultaneously. The basic model is as follows:

$$Formal_{ij} = \mu_1 + \alpha_{1i} + f_1(Age_{ij}, Cohort_i) + \gamma_i Age_{ij} + \epsilon_{ij} \quad (1)$$

$$Informal_{ij} = \mu_2 + \alpha_{2i} + f_2(Age_{ij}, Cohort_i) + \delta_i Age_{ij} + u_{ij} \quad (2)$$

Where i indexes the individual, and j indicates time. In equations (1) and (2), μ_1 and μ_2 are population-level intercepts, f_1 and f_2 represent the tensor product smoothing term determined by the model, while ϵ_{ij} and u_{ij} are within-individual residuals. The α_{1i} and α_{2i} terms represent normally distributed group-level effects for the intercept of informal and formal social participation, and γ_i and δ_i are normally distributed group-level effects for age.

I also extend the GAMM by specifying a multivariate model (i.e., more than one dependent variable) since formal and informal social participation are inextricably linked to each other at the individual level. This means that correlation is allowed (and estimated) between group-level effects (in this case, intercept and slope at the individual level) estimated from both the formal social participation model and the informal social participation model. Formally, this means that

all possible covariances between α_{1j} , α_{2j} , γ_{ij} and δ_{ij} are estimated within an unstructured variance-covariance matrix denoted below:

$$\begin{bmatrix} \sigma_{\alpha_1}^2 & \tau_{\alpha_1, \alpha_2} & \tau_{\alpha_1, \gamma} & \tau_{\alpha_1, \delta} \\ \tau_{\alpha_2, \alpha_1} & \sigma_{\alpha_2}^2 & \tau_{\alpha_2, \gamma} & \tau_{\alpha_2, \delta} \\ \tau_{\gamma, \alpha_1} & \tau_{\gamma, \alpha_2} & \sigma_{\gamma}^2 & \tau_{\gamma, \delta} \\ \tau_{\delta, \alpha_1} & \tau_{\delta, \alpha_2} & \tau_{\delta, \gamma} & \sigma_{\delta}^2 \end{bmatrix}$$

Where σ^2 indicates a variance term and τ represents covariances between each of the terms.

Further, covariance between residuals ϵ_{ij} and u_{ij} was estimated and denoted $\rho_{\epsilon, u}$. In other words, equations (1) and (2) were estimated within a single model. Non- and/or weakly-informative priors were used to produce Bayesian estimates³ and 95% credible intervals.

In order to assess how age-cohort trajectories are affected by key sociodemographic characteristics and changes across the life course, I estimate one model with only age and cohort terms (i.e., unadjusted model), and another that includes covariates⁴ (i.e. adjusted model). The model with covariates can be expressed as such:

$$Formal_{ij} = (1) + \sum_m \beta_{1m} X_{mij} + \sum_q f_{3q}(Age_{ij}) \cdot Z_{qi} \quad (3)$$

$$Informal_{ij} = (2) + \sum_m \beta_{2m} X_{mij} + \sum_q f_{4q}(Age_{ij}) \cdot Z_{qi} \quad (4)$$

Where (1) and (2) refer to equations (1) and (2) above, β_1 and β_2 are parametric population-level effects for the vector X of all covariate dummies excluding death and non-response

(indexed by m). Non-informative priors (i.e., uniform priors) were used for the population-level parametric terms. The final terms f_3 and f_4 multiplied by the vector Z of dummies for death and non-response allow the smooth function of age to vary by the values of these covariates (i.e., an interaction term)³, to account for attrition bias. Note that this is over and above the group-level linear age term already included in the model, which Lynch (2003) has previously proposed as a method to attenuate selection bias from mortality. R-hat values and trace plots showed that models displayed good convergence. All models were estimated using the brms package in R (Bürkner 2017), which relies on Stan (Carpenter et al. 2017) to execute the Markov chain Monte Carlo sampling algorithm.

RESULTS

Descriptive statistics of the sample can be found in **Table 1**. Respondents contributed a mean of 2.52 person-year observations in the model, and had an average age of 52.04. Most observations came from individuals who were female, White, had at least a high school education, with an annual household income of at least \$10,000. Further, a majority of respondents were married, employed, free from functional limitations, and had no dependent children in the home.

Table 1: Weighted Descriptive Statistics of all Person-Year Observations (N=11,755)

Variable	Mean (SD) or %
Observations per individual (range 1-5)	2.52 (1.35)
Formal social participation index (unstandardized)	2.21 (1.47)
Informal social participation index (unstandardized)	3.47 (1.09)
Age (range 25-95)	52.04 (15.69)
Gender	
Male	46.51
Female	53.49
Birth Cohort	
1911 or earlier	4.12
1912-21	9.79
1922-31	12.83

1932-41	14.93
1942-51	25.92
1952-61	32.41
Race	
Non-Hispanic White	80.46
Non-Hispanic African American	10.03
Others	9.51
Education	
Less than high school	21.24
High school diploma	57.09
College degree or higher	21.67
Annual Household Income	
Less than \$10,000	16.63
\$10,000-\$29,999	40.13
\$30,000 or higher	43.25
Dependent child in household	
Yes	35.70
No	64.30
Marital Status	
Married	68.76
Separated/Divorced	11.15
Widowed	3.24
Never Married	9.30
Employment Status	
Employed	64.16
Retired	18.23
Unemployed	7.49
Homemaker	10.12
Functional limitations	
Any limitation	16.46
No limitations	83.54
Dead	25.84
Non-response	22.61

Estimated effect sizes (the posterior means, and their 95% credible intervals) from the parametric population-level portion of the model are shown in **Table 2**. Overall, females reported higher levels of formal and informal social participation than males. While African Americans had lower levels of informal social participation ($\beta = -0.28$; 95% CI [-0.35, -0.21]), they showed higher levels of formal social participation on average ($\beta = 0.36$; 95% CI [0.29, 0.43]). Individuals with more education tended to have higher levels of formal and informal social participation, but annual household income seemed to only be positively associated with informal (and not formal) social participation.

Table 2: Parametric population-level estimates from models predicting formal and informal participation

Variable	Formal Social Participation β [95% CI]	Informal Social Participation β [95% CI]
Intercept	-0.05 [-0.14, 0.22]	-0.39 [-0.51, -0.25]
Gender		
Male	Ref.	Ref.
Female	0.13 [0.07, 0.19]	0.31 [0.25, 0.36]
Race		
Non-Hispanic White	Ref.	Ref.
Non-Hispanic African American	0.36 [0.29, 0.44]	-0.28 [-0.34, -0.21]
Others	0.08 [-0.04, 0.19]	-0.22 [-0.33, -0.12]
Education		
Less than high school	Ref.	Ref.
High school diploma	0.28 [0.21, 0.34]	0.16 [0.09, 0.23]
College degree or higher	0.49 [0.40, 0.59]	0.27 [0.19, 0.36]
Annual Household Income		
Less than \$10,000	Ref.	Ref.
\$10,000-\$29,999	-0.01 [-0.06, 0.03]	0.10 [0.04, 0.14]
\$30,000 or higher	-0.03 [-0.08, 0.03]	0.11 [0.05, 0.17]
Dependent child in household		
Yes	0.08 [0.04, 0.13]	-0.12 [-0.16, -0.07]
No	Ref.	Ref.
Marital Status		
Married	Ref.	Ref.
Separated/Divorced	-0.15 [-0.21, -0.10]	0.14 [0.07, 0.20]
Widowed	-0.05 [-0.12, 0.01]	0.20 [0.13, 0.28]
Never Married	-0.15 [-0.23, -0.06]	-0.04 [-0.14, 0.05]
Employment Status		
Employed	Ref.	Ref.
Retired	0.04 [-0.01, 0.09]	0.19 [0.13, 0.24]
Unemployed	-0.04 [-0.09, 0.02]	0.16 [0.10, 0.22]
Homemaker	0.02 [-0.04, 0.08]	0.13 [0.07, 0.19]
Functional limitations		
Any limitation	-0.09 [-0.13, -0.05]	-0.06 [-0.11, -0.02]
No limitations	Ref.	Ref.

Notes: β indicate posterior means for the coefficients. 95% CIs are based on the 2.5th and 97.5th quantiles of the posterior distribution. Bayesian credible intervals that do not contain zero are bolded.

Having a dependent child in the household was linked with increased formal social participation ($\beta = 0.08$; 95% CI [0.04, 0.13]), but lower levels of informal social participation ($\beta = -0.12$; 95% CI [-0.16, -0.07]). Compared to those who were not married (i.e., separated, divorced, widowed, never married), the general pattern of association was that those who were married had higher

levels of formal social participation, but lower levels of informal social participation. Those who were employed reported lower levels of informal social participation than those who were not (i.e., retired, unemployed, homemaker), but results did not show any statistically meaningful associations between employment status and formal social participation. Finally, those with functional limitations tended to report lower levels of both formal and informal social participation.

Marginal age trends (i.e. averaged across all cohorts) of formal and informal social participation are displayed in **Figures 1-2**. Shaded areas around the lines denote the 95% credible interval, with wider bands indicating more uncertainty in the point estimate. Both patterns follow an approximately cubic trajectory, with a plateau during mid-life (around ages 40-60). Notably, while formal social participation generally increases in early and late adulthood (with a possibility of a slight decline around age 55), informal social participation decreases across the same age ranges.

Figure 1: Marginal age trajectory of formal social participation across the life course

Figure 2: Marginal age trajectory of informal social participation across the life course

Figures 3-4 show marginal cohort trends (i.e. averaged across all ages) of formal and informal social participation respectively. As before, shaded areas indicate the 95% credible interval at each point. Large credible intervals for the ‘1911 or earlier’ birth cohort are indicative of the sparsity of the data used to estimate social participation for that cohort. As highlighted earlier, cohort effects in the accelerated longitudinal design framework are estimated from age overlaps, and since there are few overlaps with the ‘1911 or earlier’ cohort especially at higher age ranges, the credible interval is correspondingly wide. More recent cohorts show more interpretable trends. Looking at both the mean estimate and the 95% credible intervals overall, **Figure 4** seems to indicate that levels of informal social participation remain stable across cohorts. On the other hand, **Figure 3** suggests that formal social participation has increased in the youngest cohorts, especially when compared to 1922-1931 and 1932-1941 cohorts.

Figure 3: Marginal cohort trajectory of formal social participation across the life course

Figure 4: Marginal cohort trajectory of informal social participation across the life course

DISCUSSION

Social connectedness has emerged in recent decades as a key determinant of well-being (Holt-Lunstad, Smith and Layton 2010, Klinenberg 2001). Considering its importance, several studies have sought to describe how overall trends in society have changed over the years (Fischer 2011, Putnam 2000), while others have been more concerned with how it changes as individuals age (Cornwell, Laumann and Schumm 2008). This study set out to synthesize these two strands of research by describing age-cohort trends of social connectedness, using social participation as the key indicator. Panel data collected across 25 years from a sample with a wide age range provided an opportunity to empirically estimate these trends with true cohorts (rather than synthetic cohorts), and to investigate how important sociodemographic characteristics affect these trajectories.

First, age trends show disparate trajectories for formal and informal social participation. Formal social participation generally increases over the life course (especially in late life), but informal social participation shows an opposite trend. For informal social participation, findings here supplement those of Bhattacharya et al. (2016), who analyse data from mobile phone calls and show that the maximum number of connections occurs at age 25, and declines thereafter. Part of this decline is due to life course factors captured by the covariates (e.g., marriage, employment, functional decline), since a steeper downward slope is observed in the adjusted model (compared to the unadjusted model). Older adults tend to have smaller social networks (Cornwell, Laumann and Schumm 2008) and less volume of contact with friends and family, possibly due to losses in social roles and mortality/morbidity of their peers (Cornwell 2011), but the current findings seem to suggest they may compensate by engaging in more social activity within formal contexts (e.g., civic associations, religious groups) (Marcum 2013). It thus seems unlikely that an overarching process of ‘disengagement’ is occurring in late-life, even though this is observed for informal social participation. Theories from social psychology such as the socioemotional selectivity theory (Carstensen 1992) suggest that this process of narrowing social networks and reduced contact with friends and family is partly driven by the individual’s desire to engage in fewer but deeper relationships, and can in fact lead to better emotional well-being (English and Carstensen 2014). Increasing formal social participation with age in late-life is consistent with past findings from cross-sectional data (Cornwell, Laumann and Schumm 2008), but results here also show how these levels compare to earlier in the adult life course. Substantively, these changes are not trivial – over the life course, point estimates for social participation change approximately by at least one standard deviation (compared to differences by education or marital status, which show

about half the effect size [not accounting for variation in smooths, which on visual inspection not shown here, are small]). The findings compliment prior studies emphasizing the need to examine changes in the composition of social activities over the life course in greater detail (Marcum 2013). Unfortunately, long-term panel data enabling us to look more closely at the composition of social activities (e.g., time-use data) is scarce (the American Time Use Survey follows a repeated cross-section design), or tends to focus mainly on older ages (e.g., the Health and Retirement Study's Consumption and Activities Mail Survey).

Second, the results from cohort trends of formal and informal social participation lend credence to Fischer's (2011) argument that Americans' social relationships with friends and family did not change much. As seen from **Figure 4**, levels of informal social participation were very similar across cohorts. On the other hand, there is no evidence (as Putnam suggests) that there existed a 'long civic generation' thought to be born roughly between 1910 and 1940. Rather, it seems that the reverse is true. Those born after 1940 had higher (rather than lower) levels of formal social participation than the supposed "long civic generation". Based on these findings and those of Fischer (2011), it is likely that initial panic around the decline of American social connectedness was unfounded. Nevertheless, a direct estimation of the influence of sociodemographic covariates on cohort trends in formal/informal social participation validates the argument made by both Putnam (2000) and Fischer (2011) – that sociodemographic changes (e.g., delay of marriages, fewer children, more people living alone in later cohorts) across cohorts are unlikely to have much influence on cohort trends in social connectedness. Note that as with past studies, the modelling strategy here assumes that associations between sociodemographic factors and social participation are constant across cohorts, and that hypothesized effects are due to

compositional changes⁵. Other causes such as technological change or cultural shifts may instead be at work, but the current data are inadequate to evaluate the extent of influence these factors may have on social participation and/or social connectedness.

Finally, associations between covariates and social participation generally align with previous work. For instance, females are known to be more actively involved than males in both formal and informal social activities (Cornwell, Laumann and Schumm 2008, Finkel, Andel and Pedersen 2016), especially since societal expectations of gendered behaviour may place a greater burden on women to interact with family and friends – what has been called ‘kin-keeping’ (Gerstel and Gallagher 1993). African Americans have also been found to be more active in civic associations (McMiller 2000) and religious groups (Taylor, Chatters and Brown 2014). As with past studies using these data, widowed persons had higher levels of social participation (compared with married persons), but comparable rates of formal social participation (Donnelly and Hinterlong 2010, Utz et al. 2002). Factors such as having a dependent child may also lead to lower informal social participation and higher formal social participation as parents sacrifice personal time to engage more in formal contact with other parents and school-related associations (Horvat, Weininger and Lareau 2003), while functional limitations inhibit physical movement and thus restrict both formal and informal social participation (Griffith et al. 2017).

In sum, results suggest little reason for anxiety around the isolation of old age or overall societal declines in social connectedness in America. Since age is related with decreases in informal social participation but increases in formal social participation, this implies that opportunities to engage older adults through formal settings exist, possibly in the form of initiatives that promote

lifelong learning (Merriam and Kee 2014) and/or physical activity. With regard to societal change – it appears that rather than decline, there are instead gains in formal social participation, and stability in informal social participation. Opportunities for social participation seem to persist over time. Combined with observations that overall cohort change in the number of friends is positive despite advances in communication technology (Wang and Wellman 2010), predictions of generational decline in social connectedness are likely to be overstated.

I highlight some limitations of the present study, and suggestions for future research where applicable. First, findings here are limited by the type and the breadth of the measures used. These measures capture the frequency of attendance and/or interaction, and should not be conflated with related measures that look at the number of memberships in community organizations or the size of one's social network. No conclusions can be made about the composition of the personal network (i.e., who is in it), if this changes over the life course. It thus presents a limited view of social connectedness – overlooking other constituent aspects such as quality and perceived support. Nonetheless, this allows the adoption of a 'long' view, revealing important age and cohort patterns of social connectedness. Triangulation with future studies looking at life course changes in other dimensions of social connectedness is encouraged. Second, cohort changes tested here are reflective of the experience of those born before 1961. Newer cohorts may exhibit different characteristics, especially for the generation growing up as 'digital natives', who may potentially be more affected by rapid technological change over the past few decades. Third, the current method of analysis - using growth curves for accelerated longitudinal data - cannot explicitly model period effects (alongside age and cohort effects), an identification issue inherent in all age-period-cohort analysis (Yang 2011). These findings

therefore do not address the effects of contemporaneous sociohistorical events or change that may affect all living cohorts, and trends at the societal level are assumed to be due to cohort succession. Conceptually, since changes in society at any given time are unlikely to affect social participation in all ages equally unless they are especially disruptive (e.g., in the case of war or disaster), I find this to be a reasonable assumption. For instance, the use of digital devices and the Internet – perhaps the most significant drivers of change for social interaction in the past few decades (Turkle 2012) – are likely to be adopted differentially between cohorts (Ono and Zavodny 2007) rather than by all cohorts at once. Fourth, it is likely that social participation is transmitted inter-generationally, where individuals whose parents were active social participants also become highly involved in social activities (Anderson 1943, McFarland and Thomas 2006). I do not account for this because data on respondent's childhood environment was not collected, but future research could possibly seek to clarify how it affects one's age trajectory of social participation. Other interpersonal processes such as household level social dynamics between spouses and neighbourhood level cohesiveness may also affect one's social participation. The current data do not allow us to address these factors extensively, but I do not expect these to substantially alter the age-cohort trends revealed in this study, which attempt to look at long-term patterns rather than short- to medium-term ones which are more likely to be affected by interpersonal dynamics that may be subject to sudden changes (e.g., moving locations for work, school etc.). Fifth, while attempts to address attrition bias have been modelled, it cannot be said to have been completely addressed. It is possible that less connected individuals are more likely to drop out between survey waves. This could lead to an upward bias of the results. Lastly, the measure of informal social participation used in this study did not discriminate contact between friends, family, and neighbours. I am thus limited to examining overall patterns of informal

social participation. Past studies have found that as they age, individuals tend to trim out non-kin alters in their networks, retaining only their strong relationships with close kin (Carstensen 1992, English and Carstensen 2014). However, given that the average family size is shrinking due to decreasing fertility rates, younger cohorts are likely to end up keeping a larger proportion of non-kin in their networks as they age (Suanet and Antonucci 2016).

NOTES

¹The concept of social connectedness is distinct from that of ‘social capital’, which has been subjected to various definitions and operationalizations (see Hawkins and Maurer 2012 for a review). Importantly, a key division for social capital lies in whether it is property of communities/institutions (measured through networks, norms and trust), or of individuals (resources embedded in one’s networks). While the former has some relation to social participation (aggregate levels of social participation at the community level are often used as a measure of social capital), social participation in this paper is conceived as the behavior/characteristic of an individual. This is more closely linked with other measures of social connectedness such as social support and relationship quality (Cornwell, Laumann and Schumm 2008, Cornwell and Waite 2009).

²In the wave 5 interview, the phrase “telephone *or* Skype” (instead of just “telephone”) was used to adapt the question to accommodate this modern method of communication.

³The *LKJ*(1) Cholesky prior (as described in Lewandowski, Kurowicka and Joe 2009) - a prior with a uniform density over all correlation matrices of a single order – was used for the

covariance matrices of the group-level effects and residual terms. For all other parameters (all of which are standard deviations of group-level effects including the smooth terms) in the model, a half Student's $t(0,10)$ distribution with 3 degrees of freedom was used as the prior distribution for each parameter in the model. These priors are specifically chosen to provide some level of regularization (to improve convergence and sampling efficiency) while influencing the results as little as possible (Bürkner 2017).

⁴To arrive at the model specification for the adjusted model as shown, a series of separate sub-models of the form $Y_{ij} = \mu_1 + \alpha_{1i} + f_1(Age_i, Cohort_i) + f_2(Age_i) \cdot Z_i + \gamma_{ij}Age_i + \epsilon_{ij}$ were estimated, where X is a dummy (or vector of dummies) for a single covariate (e.g., marital status, employment status). Results from the sub-models were compared to the unconditional model (without covariates) using the Watanabe-Akaike Information Criterion (WAIC) to determine whether allowing asymmetry in smooths along values of the covariate would substantially improve model fit. This process did not reveal any substantial asymmetry by values of covariates. Terms allowing for asymmetry in age trajectories by death and non-response are retained mainly to address concerns about attrition bias.

⁵I explored the possibility of allowing sociodemographic variables interact with cohort smooth terms (at the same time as age), but doing so made the model increasingly difficult to estimate. Given the lack of prior evidence suggesting that the association between sociodemographic variables and social participation changes across cohorts, I found this assumption to be reasonable.

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