Three Papers on Social Participation over the Life Course

by

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DEDICATION

This dissertation is dedicated to my wife, Charmaine, for braving the uncertainty and embarking on this graduate school journey with me.

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ABSTRACT

Social participation encapsulates the involvement and participation of individuals in social activities (e.g., informal social gatherings, affiliations to community organizations), and has long been a subject of interest for sociologists. Recent scholarship has since established a strong positive association between social participation and health, suggesting that social participation can buffer the negative health effects of stress and promote healthy behavior through social influence, among other pathways. There are however three key limitations of prior research. First, perhaps driven by anxieties around rising health costs of an aging population, studies on social participation and health overwhelmingly focus on older populations. Second, many are interested in examining societal change in social connectedness over time, but given the use of repeated cross-section data, are at risk of conflating age and cohort effects. Third, research often treats social participation solely as a characteristic of the individual, even though the social participation of proximate others may also affect one's own outcomes – e.g., spouses may be influenced by their friends' health behavior, and in turn influence their partners. We know very little about how social participation operates in the context of interdependent individuals such as spousal dyads. This dissertation addresses existing gaps in the literature by applying the life course perspective to the study of social participation and health. I do this through a series of papers that (1) examine how social participation varies over age and cohort; (2) establish how the association between social participation and health changes with age; and (3) investigate how social participation and health is associated in the context of marital dyads. The first paper uses data from the Americans' Changing Lives (ACL) study, a longitudinal dataset collected from the

same individuals over 25 years (1986-2011). I employ a Multivariate Bayesian generalized additive mixed model to estimate age-cohort trajectories of formal and informal social participation. I find that changes in social participation by age and cohort are less drastic than commonly assumed; older adults seem to compensate for age-graded declines in informal social participation by increasing their formal social participation. Any anxiety around societal declines in social connectedness precipitated by past studies is overblown – later-born cohorts seem to have similar (or greater) levels of social participation compared to older cohorts. In the second paper, I use data from ACL once again, employing growth curve models to estimate how the association between social participation and health changes with age. I find that formal social participation (e.g., attendance and engagement in community groups and organizations) becomes more important for males as they age – the negative association between formal social participation and depressive symptoms becomes stronger in old age. Using data from the Health and Retirement Study, the final paper utilizes actor-partner interdependence models to examine social participation and mental health among married couples. I find evidence supporting the hypothesis that spousal social participation is positively associated with one's own mental health (i.e., partner effects), even after accounting for interdependencies in mental health between spouses. Overall, the dissertation applies life course principles to provide a more comprehensive view of social participation and its associations with health outcomes. Findings suggest that social participation in late life should be considered alongside social participation earlier in the life course, and that the social participation of proximate others can also influence our own health outcomes.

CHAPTER 1

Introduction

Social participation - that is, the involvement and participation of individuals in group life (e.g., through formal affiliations to organizations, social gatherings) - has long been a subject of interest for sociologists. Perhaps most well-known is Durkheim's (1897) view that social participation may work against anomic suicide, since individuals (he reasons) turn to suicide when they feel detached from society due to an inadequacy of social ties and/or roles. Early sociologists perceived social participation as not only essential for the achievement of group ends (e.g., advocacy, socialization), but also for the survival of the group itself (Queen 1949). They thus sought to understand how social participation differed by sociodemographic factors like socioeconomic status (Hodge and Treiman 1968), race (Klobus-Edwards, Edwards, and Klemmack 1978), age (Simmons 1952), and gender (Booth 1972).

Social participation is a part of the larger conversation and literature on social connectedness, which is a general term encompassing the quantity, quality, frequency, type and network structure of one's relationships with friends, family, and the community. The focus of social participation is the *frequency of contact with others* – it is often seen as an "objective" indicator of social connectedness alongside measures such as network size, in contrast to more "subjective" measures of social connectedness such as feelings of loneliness or perceived social support (Cornwell and Waite 2009). This focus on the social nature of activities also distinguishes it from the broader definition of "participation" as defined in the World Health Organization's International Classification of Functioning, Disability and Health (Dizon, Wiles,

and Peiris-John 2019), which is more concerned with older adults' participation in life situations including domains such as self-care and learning/applying knowledge (Badley 2008).

Social participation, however, is distinct from other commonly studied concepts of social connectedness such as social networks, social support, social integration, and loneliness. Here I describe how social participation relates to these concepts.

The study of social networks focuses on the structural properties of relationships between people (Smith and Christakis 2008). These properties may include the size (i.e., how many alters one has) and density (i.e., the ratio of the number of ties to the number of alters) of the network, as well as the nature of the ties (i.e., the links, or edges) in them. 'Ties' themselves could be operationalized in many ways – they could signify any kind of exchange, including conversation, trade, and/or provision of support. Within this broader social network framework, social participation could possibly be understood and operationalized as a *characteristic* of these ties (e.g., the strength of a tie) between an individual and his/her alters.

Social support is the amount of perceived or received support from others (Haber et al. 2007). While perceived support is a subjective measure of an individual's perception of the general availability (or satisfaction) of support, received support reflects actual behavior and may come in several forms (e.g., financial, housework help, emotional advice, care). Social participation is distinct from social support because contact does not always entail the provision or receipt of social support. However, social participation is often an antecedent to social support, since contact usually precedes the exchange of tangible support.

The concept of social integration derives from the work of Durkheim, and is broadly concerned with how embedded an individual is in society (Brissette, Cohen, and Seeman 2000). It is thought that an individual who plays multiple roles in society (e.g., father, employee,

volunteer, etc.) will have a stronger sense of identity, and therefore is less likely to feel detached and display deviant behavior. Social integration is thus typically assessed through role-based measures, which count the number of roles an individual has. Measures of social participation (i.e., contact frequency with friends and family) are sometimes used to supplement these role-based measures, to create complex indicators of social integration. In such cases, social participation can thus be seen to form one part of the broader concept of social integration.

Finally, loneliness can be seen as the perceived discrepancy between one's desired and attained social connections (Hawkley et al. 2019). It is primarily a subjective measure based on perception, and can be weakly correlated to the number and the quality of social connections that one actually has (Holt-Lunstad et al. 2015). Therefore, loneliness can operate independently of social participation, which is an objective measure of social connectedness – i.e., individuals can feel lonely despite seeing their friends and family fairly frequently.

Despite the multiplicity of measures available, there are at least two reasons to home in on social participation as a key component of social connectedness. First, social participation is conceptually antecedent to and/or forms a key part of many other concepts related to social connectedness. For instance, contact frequency is positively associated with the probability of receiving social support (Kana'iaupuni et al. 2005) and relationship quality (Mok and Wellman 2007). Social participation also forms a crucial part of social integration (Brissette et al. 2000) and social network structure, as highlighted earlier. A better understanding of social participation will likely provide insights into these other components of social connectedness as well. Second, measures of social participation have been consistently used in nationally-representative surveys since the 1980s (Veroff, Kulka, and Douvan 1981), accommodating the study of long-term trends. Among "objective" measures of social connectedness, measures of social participation

are not as susceptible to interviewer effects (i.e., good inter-rater reliability) and tend to remain stable within the same person over time (i.e., good test-retest reliability) (Bukov, Maas, and Lampert 2002; Hyyppä et al. 2008; Stansfeld and Marmot 1992). This is in contrast to measurements of ego-centric networks which have been found to vary significantly across interviewers depending on how active the interviewer is in prompting interviewees to elicit ties (Fischer 2009), and tend to experience large fluctuations over short periods of time (Small, Deeds Pamphile, and McMahan 2015).

Most studies classify social participation into two distinct types - formal (e.g., attendance and engagement in community groups and organizations) or informal (e.g., contact and activities with friends and family) social participation (van Ingen 2008a; Levasseur et al. 2010; Teele 1962). Each type of social participation is associated with different antecedents and consequences. For instance, African Americans have greater religious attendance, while Hispanics report more frequent interaction with neighbors compared to non-Hispanics (Cornwell, Laumann, and Schumm 2008a). While formal social participation is thought to strengthen 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 feelings of loneliness (Berkman et al. 2000; Cornwell et al. 2008a; Levasseur et al. 2010).

Studies have provided a solid base of evidence for a vast array of pathways through which social participation may promote desirable outcomes. For instance, social participation may buffer negative effects from stress (Thoits 2011), increase self-esteem or mastery over one's life (Mikula et al. 2016), as well as promote political engagement (Cassel 1999; Putnam 2000). It is quickly becoming more salient as a policy strategy as well, as nations seek to preserve civic identity in the face of growing discontent from globalization and increased immigration

(Margalit 2012; Morris, Kan, and Morris 2000; Youniss, McLellan, and Yates 1997), or to promote active lifestyles in the face of a rapidly aging population and an upswing in the burden of chronic disease (Adams, Leibbrandt, and Moon 2011; Raymond et al. 2013).

Yet gaps in our knowledge remain, especially around how social participation is distributed over the life course. I highlight three important limitations of past research here. First, recent studies on social participation overwhelmingly focus on social participation in later life (e.g., Adams et al. 2011; Bukov et al. 2002; Cornwell et al. 2008a), and pay little attention to situating it within the context of an individual's entire lifespan. While most studies appeal to and espouse the life course perspective, few have undertaken empirical work that truly extends across the life span. Possibly driven by the challenges arising from an aging population and bolstered by public health researchers who saw the benefits of social participation for health outcomes, current research on social participation is heavily skewed towards describing how it affects the health of the older population. There remains much less work about how social participation is itself distributed across the life course, or if similar health benefits of such participation apply to the younger population. This makes it difficult to evaluate the veracity of long held theories about aging such as disengagement (Cumming and Henry 1961), activity (Havighurst 1961) and/or continuity (Atchley 1989).

Second, many are interested in examining broader societal change in social connectedness (e.g., Fischer 2011; Putnam 2000), but are at risk of conflating age and cohort effects. For instance, Putnam (2000:275), alleges 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". But changes in social participation may occur either because the population as a whole is aging, or because younger

cohorts tend to interact less with others compared to older cohorts. However, prior studies do not empirically separate these processes, possibly due to data limitations. One example is the McDonald and Mair (2010) study, which uses a wide age range of respondents (aged 22 to 65) but cannot separate age effects from cohort effects due to their reliance on cross-sectional data. A better understanding of these processes can provide insight as to whether claims around declines in social connectedness over the past few decades have been overstated (Wang and Wellman 2010).

Lastly, we know very little about how social participation operates in the context of interdependent individuals (e.g., spouses, caregiver/care recipients, or parent/child dyads). Current studies often treat social participation as an individual behavior, ignoring the possibility that household members may mutually influence each other's trajectory of social participation and its attendant consequences. For instance, friends and family may influence one to adopt certain health behaviors, and one may in turn influence his/her spouse to follow suit. Given recent findings that the behavior of proximate members in our immediate social environment can influence our own behavior and outcomes (Christakis and Fowler 2007), it is likely that social participation may influence not just one's own outcomes but also those of significant others.

This dissertation builds upon past work on social participation with three papers which address the aforementioned gaps directly. Its aim is to strengthen our understanding of social participation by examining how social participation and its associations with health vary by age and cohort, and explore how it functions in the context of "linked lives" between spouses. These papers explicitly focus on four (out of five) life course principles advanced by Elder (1998): (1) life-span development; (2) timing in lives, (3) historical time and place; and (4) linked lives. The fifth principle of human agency – that individuals construct their own life course through choices

and actions within circumstances – is not empirically assessed, but remains an important assumption underlying all of the following analyses.

The life course perspective extends social inquiry across the whole life span, and first asserts that human development is best understood as a lifelong process – the principle of *life-span development*. This means that early life experiences provide the context for examining later life outcomes. For instance, young adults learn to participate in social activities during their schooling years, and this may then influence their patterns of social participation after they graduate (Lindsay 1984; Mahoney 2000). Social gerontologists have long debated whether it is normal for adults in late life to retreat from social life, partly because the size of their social networks (usually consisting of similar aged peers) shrink as a result of illness and mortality. Thus far, most findings have been couched in terms of disengagement (Cumming and Henry 1961) and/or activity/continuity (Atchley 1989; Havighurst 1961) when describing social participation in later life (Pinto and Neri 2017), but often do not examine how one's later life social participation differs from that in their own early adulthood.

Social participation may also have different implications depending on when it occurs in one's life – the life course principle of *timing in lives*. Sociologists have long acknowledged that societies often formally and informally structure individuals' roles and statuses according to their chronological age (Riley 1987). For instance, in most societies with advanced economies today, the typical expectation is education for children, work for adults before old age, and leisure for older adults (Riley and Riley 2000). The circumstances of one's employment (or lack thereof) are thus likely to be stronger influences on the outcomes of those in early- to mid-adulthood compared to other stages of the life course - levels of social participation are found to be highest among those who have stable jobs (Brand and Burgard 2008; Wilensky 1961).

Further, the life course perspective acknowledges cohort effects – addressing the principle of *historical time and place*. This principle states that "the life course of individuals is embedded in and shaped by the historical times and places they experience over their life- time" (Elder 1998:3). 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, Putnam (2000:257) points to "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.

The final tenet of the life course perspective that I engage with is the understanding of 'linked lives' – that "lives are lived interdependently and social-historical influences are expressed through this network of shared relationships" (Elder 1998:4). This means that individual behavior is often affected by proximate others, especially those whom one may share a close relationship with such as family members and friends (Settersten 2015). For instance, McLanahan (2004) shows that the timing of childbearing and maternal employment have important implications for children, who rely on their parent's resources. Similarly, one's social participation (especially contact with extended family) is likely linked to that of one's spouse.

In this dissertation, I address existing limitations of past research by engaging with each principle of the life course perspective mentioned above. Below, I present a brief overview of each of the papers and their contributions, along with the analytical strategy used.

My first paper (Chapter 2) describes trends in social participation over the life course by age and cohort, in line with the life course principles of *life-span development* and *historical time*

and place. It brings together two usually separate strands of the larger literature on social connectedness – (1) trajectories of social connectedness as individuals age, and (2) overall trends in social connectedness over the past few decades. I argue that social participation is a salient and stable indicator of social connectedness (as opposed to other more volatile measures such as network size), and leverage the availability of longitudinal data on this construct to estimate age-cohort trends of social participation. Data are from the Americans' Changing Lives (ACL) survey, a nationally representative panel dataset with an accelerated longitudinal design, collected over 25 years. Because data from multiple cohorts are collected over a long period of time, cohort effects can be estimated on the age overlaps (Galbraith, Bowden, and Mander 2014). This allows age and cohort effects to be separated. I use Multivariate Bayesian generalized additive mixed models (GAMMs) with a bivariate tensor spline to estimate age-cohort trajectories of formal and informal social participation, a non-parametric approach to modelling age-cohort trends given that: (1) functional forms of age/cohort trajectories are unknown (or past results have been mixed); and (2) the two constructs are highly interdependent. I find that even though informal social participation decreases with age, formal social participation increases. This points to older adults compensating for decreased informal social participation by increasing their formal social participation, resulting in a more nuanced picture of social participation compared to the theories of disengagement or activity/continuity. I find also that informal social participation remains stable across cohorts, and formal social participation increases in later cohorts. These results contradict past findings (Putnam 2000) suggesting the decline of social connectedness in American society, and lend support to those who have pointed out that moral panic surrounding this issue is precipitous and largely unnecessary (Fischer 2011; Wang and Wellman 2010).

My second paper (Chapter 3) looks at the *association* between social participation and health outcomes over the life course, in line with the life course principle of the *timing in lives*. As highlighted above, almost all studies on social participation and health look exclusively at the older adult population. Yet while social participation may primarily be used as a policy strategy for older adults to cope with loneliness or to prevent the onset of chronic illness and functional limitations (Goll et al. 2015; Holmes and Joseph 2011), the promotion of social participation among younger people tends to be more directed at promoting civic engagement and/or community organization (Driskell 2002). A younger person is therefore likely to view the purpose and importance of social participation (or lack thereof) in a different way from an older individual (Klinenberg 2012), and health benefits gleaned from participation may vary as a result. The strength of association between social participation and health outcomes may thus vary with age. Once again, I rely on data from Americans' Changing Lives (ACL) survey to estimate growth curve models of depressive symptoms and chronic health conditions, using an interaction term to test for age-varying effects of social participation. Findings show that association between formal social participation and depressive symptoms grew stronger with age, but only for men. No other age-varying associations between social participation and health were found, indicating that for the most part, social participation may be as important for well-being at younger ages as much as it is in later life.

My final paper (Chapter 4) shifts the focus to how social participation occurs at the level of "linked lives". While many studies have found social participation to be associated with better outcomes on multiple measures of mental and physical health (e.g., cognitive function, depression, and functional limitations), most scholars have seen social participation and its associations with health as solely a function of the individual and his/her characteristics, rather

than operating within the context of families. The life course principle of "linked lives", however, tells us individual behavior is often affected by proximate others, especially those whom one may share a close relationship with such as family members and friends (Settersten 2015). For instance, when has friends and family visit in one's home for an informal gathering (Fischer 2011), every member of the family is often engaged in some social contact through this process. In this paper, I use data on older couples (aged 65+) from the Health and Retirement Study (HRS) to investigate (1) How does the social participation of one's spouse affect an individual's own psychological health outcomes (i.e., depressive symptoms and cognitive function)?; and (2) Do these associations differ by gender? Dyadic growth curve models will be used to fit data from respondents who provided information (in the Psychosocial and Lifestyle Questionnaires [2006-2014] about frequency of contact with extended family, friends, and children in the HRS, using depressive symptoms and cognitive function scores as key outcomes.

In sum, the literature on social participation is vast and many have already attempted to establish its trajectory and its associations with health outcomes among older adults. My dissertation first extends this body of research by contextualizing each segment (e.g., young adulthood, mid-life, old age) of the life course within the larger context of its entirety. The first two papers in the dissertation – (1) describing patterns of social participation across age and cohort; and (2) describing how the effects of social participation may vary with age – attempt to do this by extending findings on social participation to younger populations, given most research thus far has overwhelmingly focused on older adults. Then, using data from older couples, I rely on concept of "linked lives" (Elder Jr. and Shanahan 2007) to (3) examine how social participation is associated with health in the context of heterosexual couples, bearing in mind that contact with friends and family (and their purported benefits for health) is often shared

between spouses. This furthers past research which has often seen social participation as an individual behavior (rather than influenced by one's immediate ties), and provides insight into the gendered dimensions of social participation within the household.

CHAPTER 2

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

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; Riley 1987), 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 (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, signaled 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 behavior 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 2013), some empirical work has found that social activity declines with age – that is, older people are less likely to participate in social activities (Marcum 2012; 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 and colleagues (2008b) 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 connectedness[1]: 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) (van Ingen 2008a; Levasseur et al. 2010; Teele 1962). 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 et al. 2008b; 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

[1] The concept of social connectedness is distinct from that of 'social capital', which has been subjected to various definitions and operationalizations (Hawkins and Maurer 2011). 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 2008b; Cornwell and Waite 2009).

(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 et al. 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 et al. 2002; Hyyppä et al. 2008; Stansfeld and Marmot 1992). Second, established theories of aging such as the socioemotional selectivity theory (Carstensen 1992b) 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 et al. 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 and colleagues (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, neighbors, 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 telephone[2] with friends, neighbors, 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.

[2] In 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.

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 and colleagues (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 shoveling 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 et al. 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 $\alpha_{1j}, \alpha_{2j}, \gamma_{ij}$ and δ_{ij} are estimated within an unstructured variance-covariance matrix denoted below:

$$Cov \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \gamma \\ \delta \end{bmatrix} = \begin{bmatrix} \sigma^2_{\alpha_1} & \tau_{\alpha_1\alpha_2} & \tau_{\gamma,\alpha_1} & \tau_{\delta,\alpha_2} \\ \tau_{\alpha_1\alpha_2} & \sigma^2_{\alpha_2} & \tau_{\gamma,\alpha_2} & \tau_{\delta,\alpha_2} \\ \tau_{\gamma,\alpha_1} & \tau_{\gamma,\alpha_2} & \sigma^2_{\gamma} & \tau_{\delta,\gamma} \\ \tau_{\delta,\alpha_2} & \tau_{\delta,\alpha_2} & \tau_{\delta,\gamma} & \sigma^2_{\delta} \end{bmatrix} \quad (3)$$

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 estimates[3] 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

[3] The $LKJ(1)$ Cholesky prior (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).

terms (i.e., unadjusted model), and another that includes covariates[4] (i.e. adjusted model). The model with covariates can be expressed as such:

$$Formal_{ij} = (1) + \sum_{m} \beta_{1m} X_{mij} + \sum_{q} f_{3q}(Age_{ij}) \cdot Z_{qi} \tag{4}$$

$$Informal_{ij} = \ (2) + \sum_{m} \beta_{2m} X_{mij} + \sum_{q} f_{4q}(Age_{ij}) \cdot Z_{qi} \tag{5}$$

Where (1) and (2) refer to equations (1) and (2) above, β_1 and β_2 are parametric population-level effects for the vector Z 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.

[4] To 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 Z 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.

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.

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 (β = -0.28; 95% CI [-0.35, -0.21]), they showed higher levels of formal social participation on average (β = 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.

Having a dependent child in the household was linked with increased formal social participation (β = 0.08; 95% CI [0.04, 0.13]), but lower levels of informal social participation (β = -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 that 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.

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.

Discussion

Social connectedness has emerged in recent decades as a key determinant of well-being (Holt-Lunstad et al. 2015; Klinenberg 2001). Considering its importance, several studies have sought to describe how overall trends in society have changed over the years (Fischer 2009; Putnam 2000), while others have been more concerned with how it changes as individuals age (Cornwell et al. 2008b). 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 and colleagues (2016), who analyze 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 et al. 2008b) 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 2012). 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 1992b) 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 et al. 2008b), 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 2012). 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 changes[5]. 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 et al. 2008b; Finkel, Andel, and Pedersen 2016), especially since societal expectations of gendered behavior 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) (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

[5] I 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.

and Hinterlong 2009; 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 2011) – 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 neighborhood 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 1992b; 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).

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

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

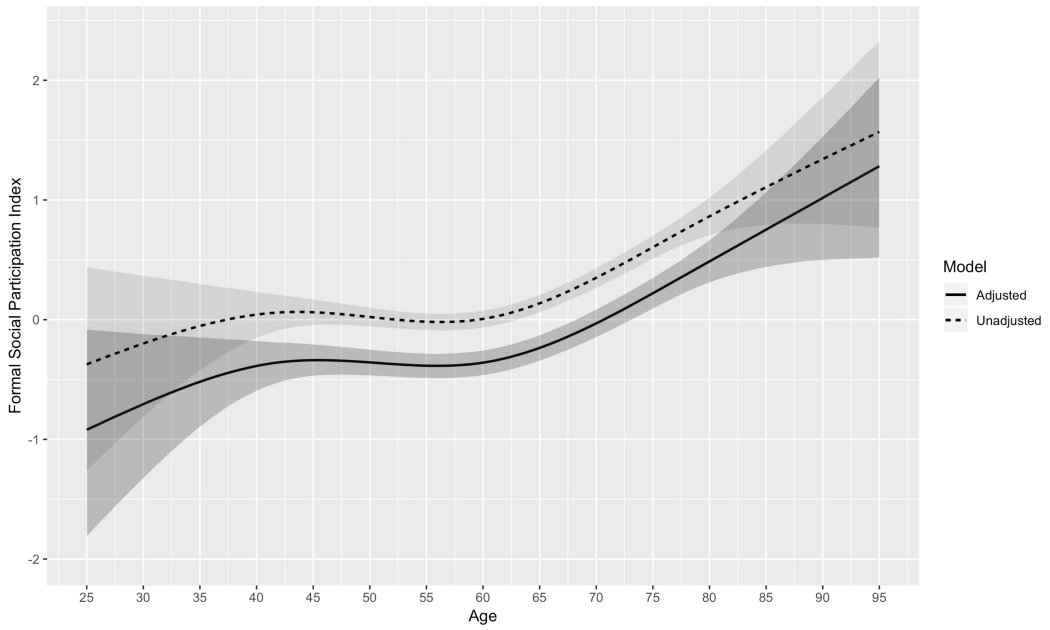

Figure 1: Marginal age trajectory of formal social participation across the life course

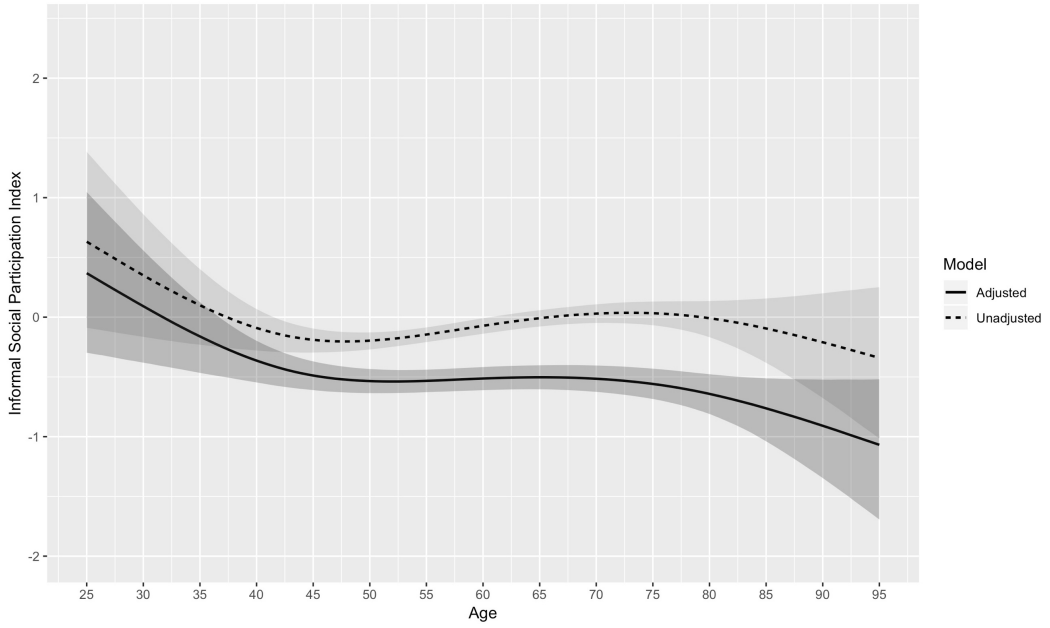

Figure 2: Marginal age trajectory of informal social participation across the life course

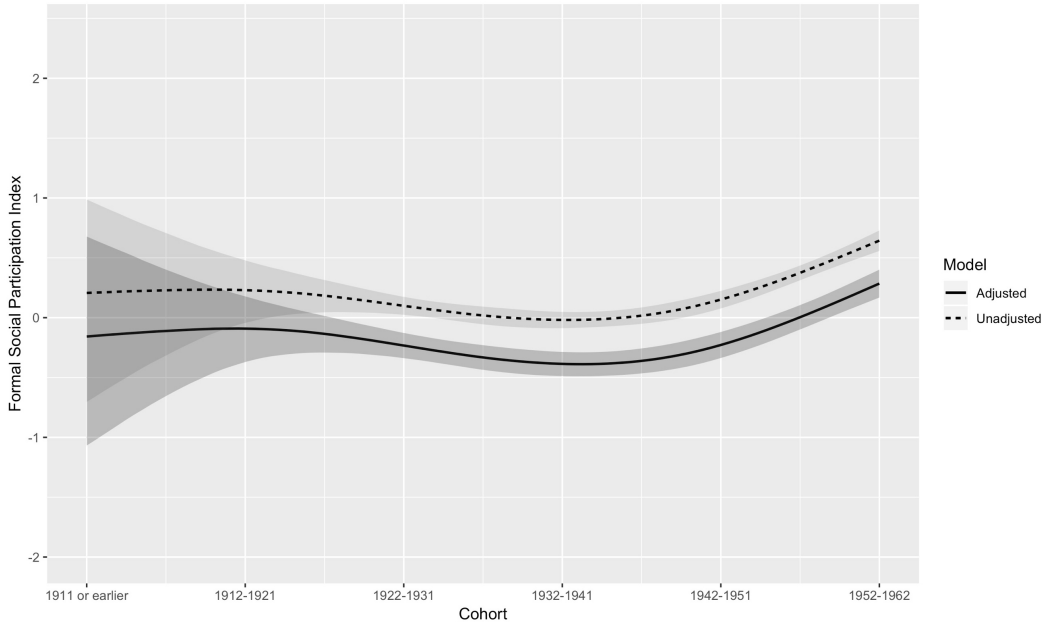

Figure 3: Marginal cohort trajectory of formal social participation across the life course

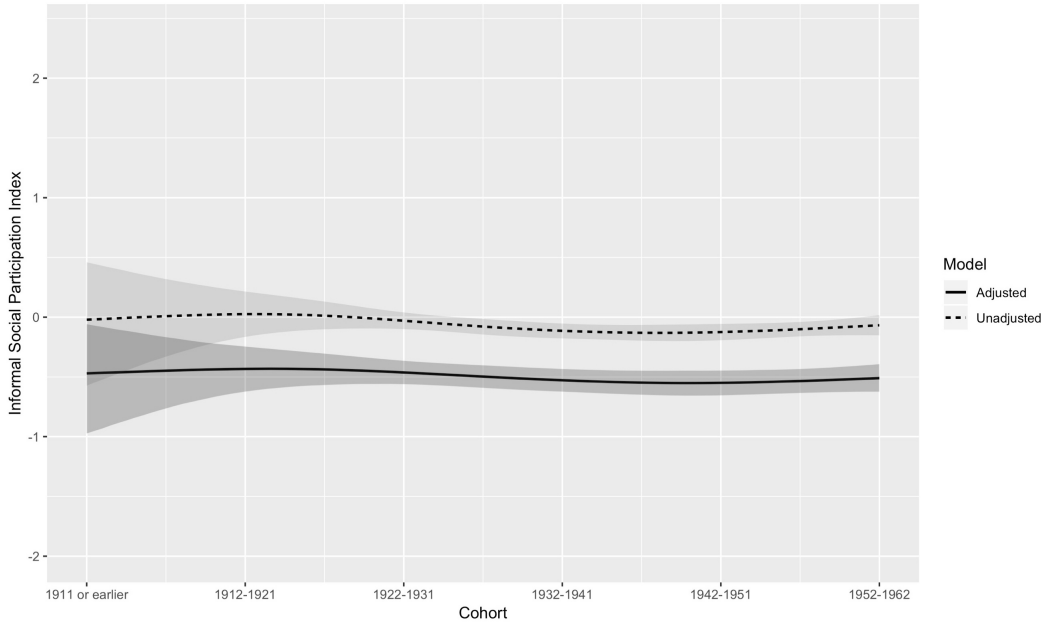

Figure 4: Marginal cohort trajectory of informal social participation across the life course

CHAPTER 3

Social participation and health over the adult life course: Does the association strengthen with age?

It is well established that social participation is positively associated with better health outcomes overall (Dahan-Oliel, Gelinas, and Mazer 2008; Leone and Hessel 2016), but also that it tends to decline with age (Bukov et al. 2002; Lee et al. 2008; Marcum 2012). To date, most studies tend to assume that salubrious health effects from social participation are consistent over the life course, and thus automatically associate lower levels of social participation with a directly proportional increase in the risk of worse health (Coyle and Dugan 2012; Klinenberg 2016). It is vital to note, however, that if the association between social participation and health varies by age, risks of worse health in later life due to a decline in levels of social participation may either be negated or amplified over time. For instance, if the strength of the association were to increase over the life course, health risks associated with a drop in social participation in later life may be amplified (compared to a drop experienced earlier in life) because of its greater salience as one ages. This underscores the need to understand social participation and its association with health outcomes as a dynamic relationship that unfolds over the life course.

Results from the few studies that do investigate age as a moderator of the social participation and health relationship have been mixed. While some researchers suggest that older adults may not be as affected by a lack of social participation compared to younger adults (Larson 1990; Sun 2017), others seem to find, in contrast, that the effect of social participation

on health increases with age (Lee et al. 2008; Myroniuk and Anglewicz 2015). It is likely that these mixed results are at least partially due to data limitations.

I therefore investigate whether and how the association between social participation and health changes with age. Analyzing nationally representative longitudinal U.S. data collected over 25 years, I examine depressive symptoms and the number of chronic health conditions as health outcomes. Results suggest that health benefits from social participation are not limited to older adults, providing only partial support for the hypothesis that health effects from social participation change with increasing age.

Background

Linking social participation to health

The presence of social ties and roles play a vital role in integrating people into society, and can influence health outcomes for both the individual and society at large. Most scholars have argued that social participation consists of two main components – formal and informal participation (van Ingen 2008b; Levasseur et al. 2010). Formal social participation entails involvement in formal groups and organizations in the community, while informal social participation refers to the level of contact and time spent with family and friends.

Health benefits from social participation have been consistently found for a wide range of physical and mental health outcomes (Dahan-Oliel et al. 2008; Leone and Hessel 2016). There is considerable evidence that social participation reduces mortality risk across a variety of geographical and cultural contexts (Agahi and Parker 2008; Berkman et al. 2004), and is positively associated with subjective health indicators such as quality of life and self-rated health (Dahan-Oliel et al. 2008; Li, Lin, and Chen 2011). Recent studies using longitudinal panel data

have also helped to establish evidence for a causal interpretation of the benefits of social participation. These studies demonstrate that social participation can slow both cognitive (Haslam, Cruwys, and Haslam 2014) and functional decline (Tomioka, Kurumatani, and Hosoi 2017), as well as reduce depressive symptoms (Croezen et al. 2015), amongst other health problems. One reason for this is that social participation promotes a stronger sense of social identity through group membership, which can in turn shape health behavior and promote self-esteem (Haslam et al. 2009). It is notable, however, that these health outcomes are differentially distributed over the life course (Clarke et al. 2011), which should be accounted for.

Social participation over the life course

The life course perspective recognizes that outcomes at every age are dynamic and cumulative, and resolves that the human experience should be understood across time (Fuller-Iglesias, Smith, and Antonucci 2009). Sociologists have long recognized that society is structured around chronological age - both formally (in the form of institutionalized age requirements and exclusions) and informally (through perceptions of age-appropriate behavior and roles) (Riley 1987). This means that individuals from different age groups are likely to occupy a different set of social roles and responsibilities (e.g., marriage, work, retirement) at each stage of the life course, and thus may experience everyday life in markedly dissimilar ways. These differences are further entrenched by societal perceptions and expectations constructed around age boundaries (e.g., too young to get married, too old to go to school) (Chudacoff 1992).

Therefore, while social participation may primarily be a strategy for older adults to cope with loneliness or to prevent the onset of chronic illness and functional limitations (Goll et al. 2015; Holmes and Joseph 2011), social participation among the youth tends to be more directed

at promoting civic engagement and/or community organization (Driskell 2002). A younger person is therefore likely to experience social participation (or lack thereof) in a different way from an older individual (Klinenberg 2012), and health benefits gleaned from participation may vary as a result.

Prior research around social participation and health, however, has typically been restricted to older adults, without considering how this association may vary for individuals in early or mid-adulthood. A large part of this emphasis on older adults is driven by uncertainties that come with an aging population. Because social participation potentially enables older adults to live longer and remain productive without extended periods of morbidity, policymakers and researchers alike have found it important to craft and test interventions targeted specifically at increasing the level of social participation among older adults (Holmes and Joseph 2011; Raymond et al. 2013).

Does age moderate the effect of social participation on health?

The proposition that the effect of social participation on health may vary between subgroups is not new. Apart from differences by age, studies have found that salubrious effects of social participation on health within the older adult population are moderated by other factors, such as socioeconomic status and gender. For instance, Ashida and colleagues (2016) find that social participation was more protective against functional disability for older adults who were more highly educated. Studies conducted in a range of countries have found that men and women benefit from different types of activities considered under the rubric of social participation (Adams et al. 2011; Leone and Hessel 2016; Li et al. 2011; Takagi, Kondo, and Kawachi 2013).

Yet, the extant literature has essentially glossed over *age* as a key modifier of the association between social participation and health. As highlighted earlier, this gap fails to account for the fact that social roles and statuses are often structured according to age, in turn affecting the ways in which one perceives and is affected by social participation. For example, Larson (1990) finds that older individuals, compared to younger, are less emotionally disturbed by solitude. An explanation for this is that while individuals are often subject to social and time pressures earlier on in life, older adults are able to see time alone as "a respite from a time in the life course when doing leisure alone was not as viable" (Marcum 2012:635). While this intuition expects that the effects of social participation (especially on mental health) will diminish in later life since one gradually learns to cope with 'alone time', it should also be noted that pathways from social participation to health appear to be more pertinent for older adults. For instance, social participation reduces feelings of isolation, partly through enabling role continuity/replacement through continued engagement with familiar others and promoting greater personal mastery (Thoits 2011). These experiences, however, are more common to older persons (Coyle and Dugan 2012), who are more likely to face role-identity absences as work and childrearing responsibilities subside in later life. A reduced sense of personal mastery also tends to come with increasing age, due to decreased mobility (Jang et al. 2002).

Given increasing numbers of older adults who live alone in America's aging society – and seldom by choice (Klinenberg 2001) – factors surrounding the concomitant loss of social roles and physical functioning in later life are likely to outweigh the possibility of enjoying (or coping with) time alone (Larson 1990). This is in stark contrast to younger adults, who are often more in control of how and when to spend time alone (Klinenberg 2012). Further, given that a primary way that social participation affects health is through the strengthening of social norms

and social identity (Haslam et al. 2009; Thoits 2011), social participation may be more important for the health of older (compared to younger) adults since they are more likely to face losses in social roles and group memberships with fewer chances of regaining them (e.g., going back to work, becoming a parent to a young child again). Consequently, it may be expected that social participation will begin to matter more (rather than less) as one grows older.

To date, most studies considering age trajectories across the adult life span only address how the prevalence of social participation (and not its association with health) changes through the aging process. Some scholars suggest that informal participation decreases with age because one has fewer living friends and family (Ajrouch, Blandon, and Antonucci 2005; Morgan 1988). Older adults have also been thought to spend less time with others in general, regardless of the activity in question (Marcum 2012). The socioemotional selectivity theory (Carstensen 1992a) understands this as a move toward a smaller social network and better quality of relationships based around close and friends in later life. On the other hand, others have argued that while forms of participative activities may change through the aging process to adapt to the onset of functional limitations and changes in networks, overall levels of participation tend to remain stable (Bukov et al. 2002). These studies, however, often implicitly assume that the strength of the association between social participation and health remains constant across the life course. Those who engage less regularly in socially participative activities at older ages are thus often perceived as being at greater risk of worse health (Coyle and Dugan 2012; Klinenberg 2016).

Current evidence from studies investigating whether age modifies the effects of social participation on health provide, at best, mixed conclusions. Many of these studies delimit their sample to older adults (i.e. aged 65+), and are mainly concerned with mortality as an outcome. Most then find support for the hypothesis that the benefits of social participation for health

decline with age. For instance, Bowling and Grundy (2008) find in the United Kingdom that social participation reduces the risk of 20-year mortality for those aged between 65 to 85, but not for those above 85 years of age. Analyzing data from a large Chinese sample, Sun (2017) also finds that the protective effects of social participation against 6-year mortality diminishes with increasing age. By contrast, results from a handful of studies analyzing data wide from a wider age range tell a very different story. Lee and colleagues (2008) find among South Koreans that the association of social participation with self-rated health in fact increases with age. Similarly, Myronuik and Anglewicz (2015) find in Malawi that participation in monthly social events are associated with better physical health after two years, but only for those aged 45 and above.

Research objectives

Prior research specifically addressing age as a moderator has two key limitations. First, because most studies are limited to older adults, we only have a partial understanding of how social participation affects health over the life course. Thus, while researchers and policymakers are often quick to depict social participation as vital "for older adults", it remains difficult to gauge whether these effects continue from younger ages or suddenly become more pronounced after entering "old age". Second, studies that do include a wider age range are either cross-sectional (e.g., Lee et al. 2008), or have short periods of follow-up (e.g., Myroniuk and Anglewicz 2015). They therefore do not consider trajectories of health over extended periods, and may be capturing health differences between cohorts instead of by age. This article addresses both these limitations, and contributes to the conversation around social participation and health by seeking to answer a key research question: Does the effect of social participation on health change with age? I test two broad hypotheses.

Hypothesis One – There is a positive association between social participation and health across the life course

Hypothesis Two – The effect of social participation on health increases with age

To do so, I use longitudinal data collected over 25 years to examine the age trajectories of two health outcomes – (1) the number of chronic health conditions; and (2) the extent of depressive symptoms – and examine how social participation affects the shape of these trajectories. Both these outcomes are becoming increasingly important, as depression remains one of the leading causes of disease burden worldwide (Moussavi et al. 2007), and adults with multiple chronic health conditions are becoming increasingly common (Ward, Schiller, and Goodman 2014). Social participation is pertinent here because it has been shown to be protective against depression (Croezen et al. 2015; Cruwys et al. 2013) and may delay or prevent the onset of chronic diseases (Holmes and Joseph 2011).

Data and Methods

Data are from the American Changing Lives survey (House et al. 2005), a nationally representative panel study of adults aged 25 and above in 1986 (N=3617). At baseline, a multistage stratified area probability sample was drawn from the United States population and interviewed face-to-face, with a response rate of 68%. Follow-up interviews were then conducted in 1989 (*N*=2867), 1994 (*N*=2562), 2002 (*N*=1787), and 2011 (*N*=1427) through phone interviews. Those who were lost to follow-up in subsequent waves were more likely to be older, male, from a minority ethnic group. I analyze data from all five waves of data collection, running

analyses on all observations where information on depressive symptoms (10939 person-year observations, baseline $N = 3496$) and number of chronic health conditions (11202 person-year observations, baseline $N = 3617$) are available.

Measures

Dependent variables**.** Depressive symptoms were measured using the 11-item version of the Center for Epidemiologic Studies Depression (CES-D) Scale, with possible scores on this measure ranging from zero to 22 (Kohout et al. 1993). Higher scores indicated more depressive symptoms. For chronic health conditions, an index (or count) of the number of clinically diagnosed chronic health conditions (including heart disease, diabetes, cancer, arthritis, hypertension, stroke, emphysema) based on self-report was created at each wave, and used in the analysis.

Key independent variables**.** The measures for formal and informal social participation are derived from work in Veroff and colleagues (1981), and have been used in a number of previous studies analyzing ACL data (Donnelly and Hinterlong 2009; Umberson et al. 1996). The inclusion of formal/informal social participation as separate variables is important given that each type has been shown to affect health outcomes differently (Haslam et al. 2014). 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, neighbors, 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

telephone with friends, neighbors, or relatives?" Response categories for questions (a), (b), and (c) 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 (d) 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 treated as continuous scores, which were then reverse-coded and summed to create an index score for formal/informal social participation. Lastly, they were standardized (i.e. rescaled to have a mean of zero and variance of one) before including it into the model.

Covariates**.** Age across all person-year observations ranged from 25 to 95 and older (those aged older than 95 were recoded to 95 due to small sample sizes in that age range). To ease interpretation of estimates, age was centered around its lower limit (i.e., age 25 was set to zero). 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). The cohort indicator was included in the model as a continuous variable, as in Yang and Lee (2009), to improve model fit. Sociodemographic variables used in the analysis are race (non-Hispanic white, non-Hispanic African American, other races), education (less than high school, high school diploma, college degree or higher), inflation-adjusted (to 1986 dollars) annual household income in the last 12 months (Less than $10,000, $10,000-29,999, $30,000 and above), marital status (married, separated/divorced, widowed, never married) and employment status (employed, unemployed, retired, homemaker). All covariates except for race and education were time-varying.

Statistical Analysis

Growth curve models were used to analyze data in an accelerated longitudinal design framework, to estimate the trajectory of depressive symptoms and chronic health conditions by age. The accelerated longitudinal design is especially useful for life course research because it enables longitudinal analysis over a wide age range with a comparatively shorter study time frame, by linking overlapping data from multiple cohorts. Growth curve models can then produce accurate age trajectories by adjusting for cohort differences and taking into account within-person clustering (Raudenbush and Chan 1992). It can also handle unbalanced designs (or partially missing data) where each person contributes anywhere between 1-5 time points of data (Curran, Obeidat, and Losardo 2010).

All statistical models were weighted to account for sample design and non-response, making the sample representative at each wave of the population ages 25 years and above living in the United States in 1986. Given that both determinants and age trajectories of these health outcomes are likely to differ by gender (Denton, Prus, and Walters 2004; Yang 2007), models were stratified by gender. To ensure consistency in hypothesis testing via the estimated standard error, a zero weight was assigned for women observations in the model for men and vice versa, so that the full sample is included in calculations of the standard error (Rao and Molina 2015) but not the beta coefficients.

A two-level model was used for this analysis, with repeated measurements (level one) nested within individuals (level two). Age was used as the 'growth' variable (i.e. an indication of time), thereby creating a synthetic cohort from ages 25 to 95. Unconditional growth models were first estimated to plot and predict the trajectory of the outcome variables. Non-linearity was addressed by including higher-order terms for age. The same process was then used to account for cohort effects, testing also for interaction effects between cohort and age. Model selection

was guided by both the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC). A stepwise process was used to determine the final models for each gender and outcome. First, age trajectories for the outcome variable of interest were estimated. Once the best fitting model incorporating age and cohort effects was reached, interaction variables between age and social participation indicators were then included to test for age-varying effects of social participation on the outcome variable. Subsequently, covariates were adjusted for, and non-significant interaction terms dropped to constitute the final model. Random effects were estimated for the intercept and linear age effect only, because models including random effects for higher order terms failed to converge. All covariates were included as dummy variables in the growth curve model.

The full model (tested separately for each gender) can be expressed formally with the following equation, incorporating both fixed and random effects. The outcome variable (*Y*) at time *t* is nested within each individual (*i*):

$$\begin{aligned} Y_{it} = \; & \pi_{0i} + \beta_1 F_i + \beta_2 I_i + \beta_3 F_i (age-25)_{it} + \beta_4 I_i (age-25)_{it} \\ & + \; \pi_{1i} (age-25)_{it} + \sum_{a=2}^{K} \beta_{5a} (age-25)_{it}^{a} + \sum_{b=1}^{K} \beta_{6b} \, C_i^b \\ & + \sum_{c=1}^{K} \beta_{7c} \, C_i (age-25)_{it}^{c} + \sum_{q=1}^{q=8} \beta_{8q} \boldsymbol{X}_{qit} + \sum_{v=1}^{v=4} \beta_{9v} \boldsymbol{Z}_{vi} + r_{it} \end{aligned} \tag{6}$$

Where beta coefficients represent fixed effects, and equations for the random intercept (π_{0i}) and slope (π_{1i})) may be presented as follows:

$$\pi_{0i} = \beta_{00} + e_{0i} \quad (7.1)$$

$$\pi_{1i} = \beta_{10} + e_{1i} \quad (7.2)$$

In equation (6), the health outcome (Y) is modeled as a function of age, cohort (C), formal social participation (F), informal social participation (I), as well as dummy variables for time invariant (v = 1 to 4) and time-varying covariates (q = 1 to 8). The value of K in each case depends on the shape of the age trajectory that best fits the data according to AIC and BIC (e.g., for a quadratic trajectory, K will equal two). I also reference previous work (Clarke et al. 2011; Gorman and Read 2006; Liang et al. 2008) to confirm that the shape of these trajectories correspond reasonably to prior findings, before proceeding to test the effects of social participation. Person-level variability around the intercept (e_{0i}) is assumed to be normally distributed with mean zero and variance τ_{00}. Similarly, person-level variability around the slope (e_{1i}) is assumed to be normally distributed with mean zero and variance τ_{11}. Unstructured covariance between e_{0i} and e_{1i} is allowed and denoted τ_{0i}. All errors at the person-level are assumed to be independent from the within-person errors (r_{it}). This model specification has been shown to provide accurate estimates even under an autoregressive process (Murphy and Pituch 2009), and therefore is likely robust to issues of reverse causality.

Several model checks were also conducted. First, Poisson growth curve models were estimated when number of chronic illnesses (which is a count variable) was used as the outcome, but models failed to converge once random effects were included. Poisson growth curve models excluding random effects produced almost identical results when compared to linear growth curve models. The findings presented are therefore based on linear growth curve models, since they provided more flexibility and consistency within the scope of this paper. Second, alternate

model specifications using splines and higher order age terms were tested to reflect the possibility that life stage (rather than age) could moderate the relationship of interest. Based on AIC and BIC however, these models did not provide a better model fit.

Results

Table 3 describes the sample at baseline for all 3617 cases, weighted to account for sampling design. The ACL sample is made up of majority women, Non-Hispanic Whites, with an overall mean age of 47.1. Compared to men, women had more depressive symptoms and chronic health conditions, but also had higher levels of formal and informal social participation. Further, women in the sample were significantly older, less educated, had lower household income, less likely to be married, and less likely to be employed, compared to men.

Figures 5 and 6 show the age trajectories of depressive symptoms and chronic illnesses estimated from the unconditional growth curve models respectively. Women reported higher depressive symptom scores and more chronic health conditions on average, even though the extent of this gender difference varied over the life course. Inclusion of higher order terms for both age and cohort in the models were guided by model fit indices. The observed trajectories approximate previous findings examining these outcomes over the life course (Clarke et al. 2011; Gorman and Read 2006; Liang et al. 2008).

Table 4 displays the results from growth curve models predicting depressive symptoms, using the stepwise process described above. Based on model fit, a quadratic term for age as well as an interaction term between cohort and age was included in the model. Fixed effects here represent the average effect of a variable on the outcome of interest. For men, the interaction term between formal social participation and age remained statistically significant after adjusting

for covariates. This indicates that for men, the effect of formal social participation on depressive symptoms changes with age. The main effect of informal social participation was statistically significant at the level of a one-tailed test (i.e., $p<0.10$), but there was no evidence of age moderating this effect. For women, evidence for the protective effect of both informal and formal social participation was found, but these effects were not moderated by age. Because interpretation of interaction effects is difficult especially with continuous variables, a visualization of these findings is presented in Figure 7. The plot represents graphically the disparities in the age trajectory of an adult with different formal social participation levels (one standard deviation above and below the mean). For men, it can be observed that the gap widens with age, showing that the protective effect of formal social participation increases with age. In contrast, for women, the gap remains consistent across the life course, indicating a constant protective effect of formal social participation across all ages.

Table 5 shows the estimates from the growth curve models with the number of chronic health conditions as an outcome. A cubic term for age and a quadratic term for cohort were included, being the best fitting model among those tested. In unadjusted models, only the main effect for formal social participation was statistically significant. This main effect did not hold for men after adjusting for covariates, but it remained statistically significant for women. These results show that while formal social participation was protective against chronic health conditions for women, its effect did not change with age.

Discussion

Using five waves of panel data collected over 25 years, this article has sought to clarify whether the effects of social participation on health increases with age, given that previous

studies have produced mixed results. A key strength of this analysis is the use of an accelerated longitudinal design and data from adults across the adult life course, enabling the estimation of health trajectories across a wider age range than in past studies (which have often focused only on older adults). Growth curve models with an accelerated longitudinal design (Raudenbush and Chan 1992) were utilized to construct these trajectories, and then test the hypothesis that the association of social participation with health is moderated by age. Only partial evidence is found to support this hypothesis.

In terms of depressive symptoms, evidence for the moderating effect of age was found only for the effects of formal social participation among men. A plausible explanation, as Williams (2008) highlights, is that men's sense of self and identity tend to be rooted in work and occupational status. Formal social participation may therefore become more important as men age into later life, by helping to fill role absences and ensuring continuity in the midst of the transition out of employment (Goll et al. 2015). Women do not seem to experience the same process of formal social participation becoming more salient for mental health as they age. Instead, for women, the effects of both formal and informal social participation on depressive symptoms appear to be consistent across the life course. My findings reiterate previous research articulating the benefits of social participation in reducing older adults' depressive symptoms (Croezen et al. 2015; Takagi et al. 2013), but go further to illumine how these effects are distributed in early- and mid-adulthood. Notably, men and women glean different protective effects from formal social participation in earlier stages of life, even though both sexes similarly benefit in later life. Given that social participation tends to be stable over time within individuals (Stansfeld and Marmot 1992), it may be valuable to promote social participation earlier on in the life course. Greenfield and Moorman (2017) have recently found that independent of

socioeconomic factors, high school extracurricular involvement is positively associated with participation in voluntary associations during later life, supporting the notion that early life interventions may have lasting effects over time. Promoting social participation at earlier points in the life course then becomes important if preventing the onset of depressive symptoms is desired (Cruwys et al. 2013), particularly for women whose mental health may derive not only long-term, but also immediate benefits.

In models predicting the number of chronic health conditions by age, only one statistically significant effect relevant to the hypotheses was found - formal social participation was protective for women, but not for men. Informal social participation did not seem to affect the trajectory of chronic health conditions for either men or women. I offer two preliminary ways to interpret these results. First, the more consistent effect of formal social participation across both depressive symptoms and chronic health conditions is likely linked to its ability to more strongly reinforce a sense of social identity in individuals through group membership. Social identity theory postulates that group identification affects the way in which individuals appraise/respond to physical symptoms, and asserts an influence on health behavior (Haslam et al. 2009). A number of studies (e.g., Haslam et al. 2014; Sani et al. 2012) have previously found that activities enhancing group identification have stronger effects on health outcomes than mere social contact with friends and family. Second, observed gender differences in the effect of formal social participation for chronic health conditions may reflect differences in the way which health information is presented to men and women in formal settings. Smith and Robertson (2008) highlight that while formal health promotion efforts have rightly focused on lived experiences when working with women, they fail to do so for men. Instead, they argue, these efforts have "tended to interpret masculinity simplistically, equating it with a set of (usually

negative) characteristics" (Smith and Robertson 2008:284). This may lead to differences in the way health information is received and acted upon, which possibly explains why only women gain (physical) health benefits from formal social participation. Further research is needed to explore and validate the gender differences in these pathways to health.

These findings should also encourage researchers to further explore if, and how, social participation affects the onset of chronic health conditions. While Holmes and Joseph (2011) have proposed in principle that social participation can play an important role in the prevention and management of chronic conditions through health-related social control and the spreading of health information, research exploring the link between social participation and chronic conditions has been scarce. Where available, studies often either posit that chronic health conditions affect social participation (Griffith et al. 2017), or study the effect of social participation among those already suffering from chronic health conditions (Anaby et al. 2011). These studies however, utilize cross-sectional data and are unable to empirically establish a causal direction. The present findings, using longitudinal panel data, are novel and demonstrate that it may be useful to reduce the prevalence of comorbidity in older adults. The exact ways and mechanisms through which social participation may exert its influence in individuals over the long haul, however, needs to be explored in greater depth.

I note several limitations of the present study. First, the indexes used for social participation are constructed using relatively general questions. Information on specific activities (e.g., eliciting whether contact was mostly with friends, family, neighbors, or relatives) was not collected from respondents. The indexes here however have demonstrated good predictive validity when used in previous studies (e.g., Donnelly and Hinterlong 2009; Umberson et al. 1996), and are useful because they have been asked of the same individuals over a long period.

Second, while I have explicitly modelled age and cohort effects in the trajectory of the outcome variables (i.e. depressive symptoms and chronic conditions) here, it is assumed that the association between social participation and health did not vary by cohort. An interaction effect between social participation was included, but problems with multicollinearity were encountered. Models that included only the social participation-cohort interaction effect (without the social participation-age interaction) had an inferior fit. This is however unlikely to be a problematic assumption, given that social participation has had fairly consistent effects across multiple cohorts of older adults (Adams et al. 2011; Croezen et al. 2015; Holt-Lunstad, Smith, and Layton 2010; Pinto and Neri 2017).

Overall, these findings provide a more nuanced view of the health-related effects of social participation than has been typically assumed. It is not entirely the case that the effects of social participation are more pronounced at older ages, nor that they are always consistent over the life course. I have shown here that the validity of both assumptions often depends on gender, the type of social participation, as well as the kind of health outcome being considered. Researchers and policymakers should consider these complexities when crafting interventions to promote social participation in older adults, and remain cognizant that processes of social participation and health are spread across the life course.

Table 3: Weighted Descriptive Statistics at Baseline (N=3617)

Variable	**All** Mean (*SD*) or %	**Men (*N*=1358)** Mean (*SD*) or %	**Women (*N*=2259)** Mean (*SD*) or %	**Difference**[a]
Waves of data per individual (range 1-5)	2.42 (1.30)	2.42 (1.16)	2.43 (1.42)	N.S.
Depressive symptoms score	4.48 (3.97)	3.98 (3.20)	4.92 (4.60)	$p<0.001$
Number of chronic health conditions	0.78 (1.05)	0.68 (0.88)	0.87 (1.19)	$p<0.001$
Formal social participation	0.00 (1.00)	-0.06 (0.89)	0.06 (1.09)	$p<0.01$
Informal social participation	0.00 (1.00)	-0.15 (0.91)	0.14 (1.05)	$p<0.001$
Age (range 25-95)	47.11 (16.44)	45.98 (14.20)	48.12 (18.30)	$p<0.001$
Birth Cohort				
1911 or earlier	6.99	6.08	7.79	$p<0.05$
1912-21	12.46	10.63	14.08	
1922-31	13.76	13.55	13.95	
1932-41	14.55	15.81	13.43	
1942-51	23.22	22.66	23.72	
1952-61	29.02	31.26	27.03	
Race				
Non-Hispanic White	79.24	80.45	78.16	N.S.
Non-Hispanic African American	10.77	9.88	11.57	
Others	9.99	9.67	10.28	
Education				
Less than high school	25.58	24.85	26.24	$p<0.001$
High school diploma	54.69	51.07	57.90	
College degree or higher	19.73	24.08	15.86	
Annual Household Income				
Less than $10,000	19.18	14.35	23.47	$p<0.001$
$10,000-$29,999	40.54	40.81	40.30	
$30,000 or higher	40.28	44.84	36.22	
Marital Status				
Married	69.38	75.74	63.72	$p<0.001$
Separated/Divorced	11.67	8.75	14.28	
Widowed	8.72	3.31	13.55	
Never Married	10.22	12.21	8.46	
Employment Status				
Employed	65.53	77.19	55.15	$p<0.001$
Retired	14.84	16.18	13.64	
Unemployed	7.51	6.16	8.71	
Homemaker	12.13	0.48	22.50	

[a]For dichotomous and continuous variables, Wald tests were used to ascertain the p-value of the difference. For categorical variables, Chi-squared tests were used.

Table 4: Results from Growth Curve Models for Depressive Symptoms

	Men (*N*=1319)[a] *β* (*SE*)				**Women (*N*=2177)[a]** *β* (*SE*)			
Variable	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Rate of Change								
Age	-0.27***	-0.27***	-0.26***	-0.26***	-0.21***	-0.21***	-0.18**	-0.18***
	(0.06)	(0.06)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Age^2	3e-03***	3e-03***	2e-03***	2e-03***	2e-03***	2e-03***	2e-03**	2e-03**
	(5e-04)	(5e-04)	(5e-04)	(5e-04)	(5e-04)	(5e-04)	(5e-04)	(5e-04)
Cohort	-1.11***	-1.11***	-1.05***	-1.06***	-0.70**	-0.72**	-0.56*	-0.57*
	(0.29)	(0.29)	(0.28)	(0.28)	(0.27)	(0.27)	(0.26)	(0.26)
Cohort x Age	0.02**	0.02**	0.02**	0.02**	0.01+	0.01+	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Fixed Effects								
Formal Social	-	-2e-03	0.05	0.05	-	-0.45***	-0.37**	-0.40***
Participation	-	(0.15)	(0.15)	(0.15)	-	(0.14)	(0.13)	(0.06)
Informal Social	-	-0.07	-0.10	-0.13+	-	-0.03	-0.04	-0.18**
Participation	-	(0.15)	(0.15)	(0.07)	-	(0.15)	(0.15)	(0.07)
Formal Social	-	-8e-03*	-8e-03*	-9e-03*	-	-8e-04	-7e-04	-
Participation x	-	(4e-03)	(4e-03)	(4e-03)	-	(3e-03)	(3e-03)	-
Age								
Informal Social	-	-1e-03	-1e-03	-	-	-6e-03	-5e-03	-
Participation x	-	(5e-03)	(4e-03)	-	-	(4e-03)	(4e-03)	-
Age								
Adjusted for Covariates[b]?	NO	NO	YES	YES	NO	NO	YES	YES
Fit Indices								
AIC	25412	25389	25125	25123	31329	31224	30947	30945
BIC	25477	25484	25308	25298	31395	31319	31129	31113

Notes: +p<0.10, *p<0.05, **p<0.01, ***p<0.001. [a]Number reflects baseline sample size. [b]Covariates include race, annual household income, marital status, and employment status. Some coefficients and standard errors appear as zero to the second decimal point because the values are very small.

Table 5: Results from Growth Curve Models for Chronic Health Conditions

	Men (*N*=1358)[a] *β* (*SE*)				**Women (*N*=2259)[a]** *β* (*SE*)			
Variable	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Rate of Change								
Age	-0.01	-0.01	-0.01	-0.01	-0.02**	-0.02**	-0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Age^2	2e-03***	2e-03***	1e-03***	1e-03***	2e-03***	2e-03***	2e-03***	2e-03***
	(3e-04)	(3e-04)	(3e-04)	(3e-04)	(2e-04)	(2e-04)	(3e-04)	(3e-04)
Age^3	-1e-05***	-1e-05***	-1e-05***	-1e-05***	-2e-05***	-2e-05***	-2e-05***	-2e-05***
	(3e-06)	(3e-06)	(3e-06)	(3e-06)	(3e-06)	(3e-06)	(3e-06)	(3e-06)
Cohort	0.30***	0.29***	0.31***	0.32***	0.36***	0.36***	0.39***	0.39***
	(0.08)	(0.08)	(0.08)	(0.08)	(0.06)	(0.06)	(0.06)	(0.06)
$Cohort^2$	-0.04***	-0.04**	-0.04**	-0.04**	-0.04***	-0.04***	-0.04***	-0.04***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Fixed Effects								
Formal Social	-	-0.06*	-0.05+	-0.02	-	-0.06*	-0.05*	-0.04**
Participation	-	(0.03)	(0.03)	(0.02)	-	(0.03)	(0.02)	(0.01)
Informal Social	-	-1e-03	0.01	0.03	-	3e-03	0.02	0.01
Participation	-	(0.03)	(0.03)	(0.02)	-	(0.03)	(0.03)	(0.01)
Formal Social	-	1e-03	1e-03	-	-	4e-04	4e-04	-
Participation x	-	(1e-03)	(1e-03)	-	-	(8e-04)	(8e-04)	-
Age								
Informal Social	-	8e-04	4e-04	-	-	-5e-04	-6e-04	-
Participation x	-	(1e-03)	(1e-03)	-	-	(8e-04)	(8e-04)	-
Age								
Adjusted for Covariates[b]?	NO	NO	YES	YES	NO	NO	YES	YES
Fit Indices								
AIC	11849	11848	11772	11772	15426	15419	15256	15252
BIC	11922	11951	11963	11947	15499	15522	15446	15428

Notes: +p<0.10, *p<0.05, **p<0.01, ***p<0.001. [a]Number reflects baseline sample size. [b]Covariates include race, annual household income, marital status, and employment status. Some coefficients and standard errors appear as zero to the second decimal point because the values are very small.

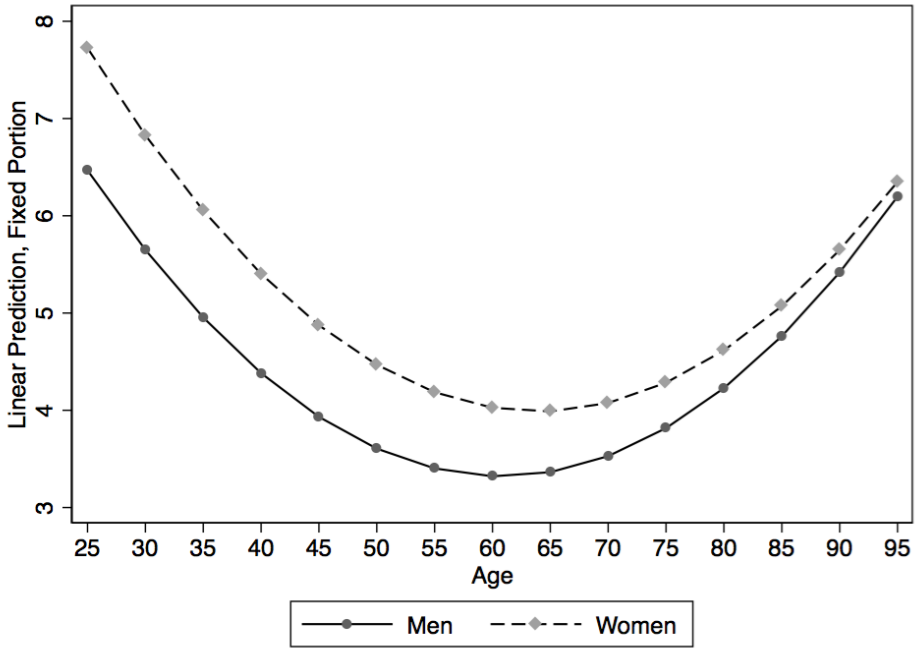

Figure 5: Age trajectory for depressive symptoms from unconditional growth curve models

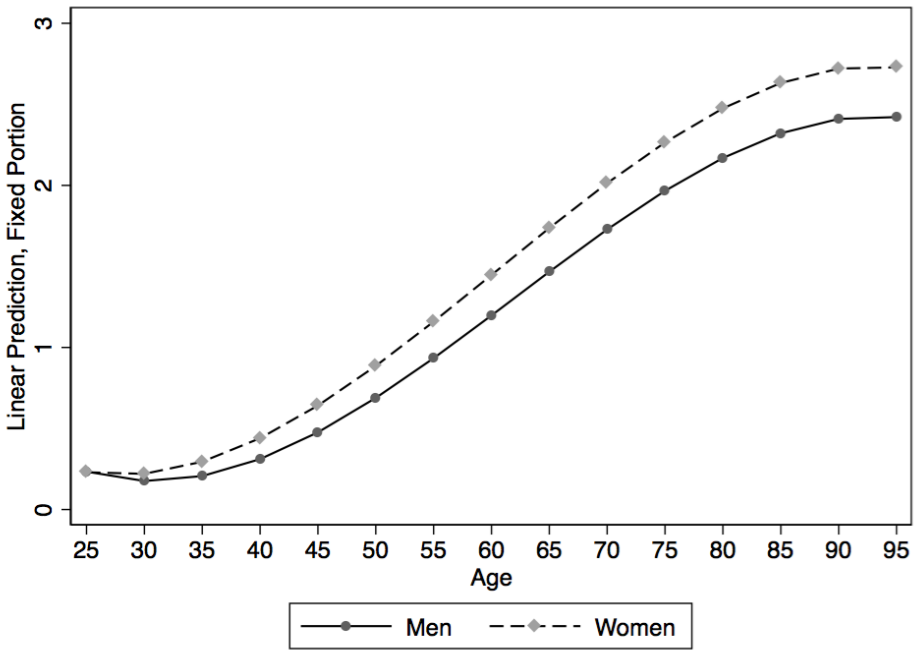

Figure 6: Age trajectory for number of chronic health conditions from unconditional growth curve models

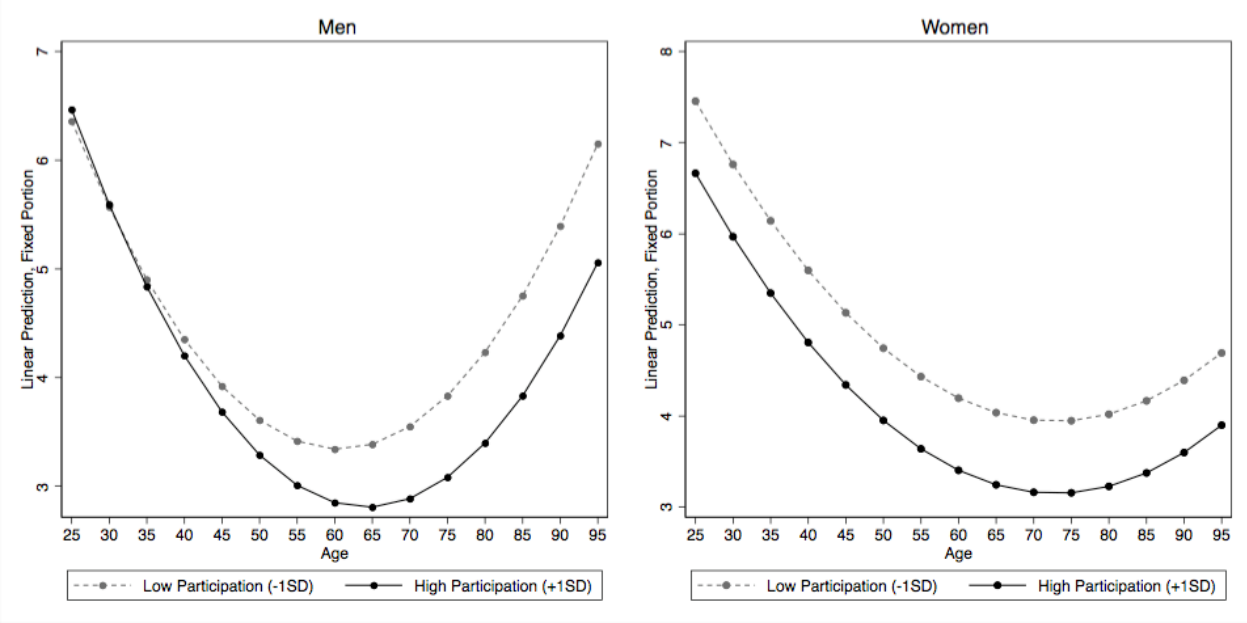

Figure 7: Growth curves for depressive symptoms at different levels of formal social participation, by gender

CHAPTER 4

Your friends, my friends, and our family: Informal social participation and mental health through the lens of linked lives

Humans function best when connected to significant others such as friends and family members, rather than in isolation. A large body of literature suggests that social ties promote health in substantial ways (Umberson and Montez 2010) – they give us a sense of belonging, access to social support in times of need, and influence us to adopt better health behaviors (Thoits 2011). These health-promoting effects may even grow over time (e.g., Ang 2018; Bourassa et al. 2017), partly because people tend to evaluate their social relationships more positively as they age (Luong, Charles, and Fingerman 2010). Individuals also begin to focus on nurturing more intimate ties (as opposed to weak or solely instrumental ties) as they grow older (Carstensen, Isaacowitz, and Charles 1999), from which they may reap greater emotional benefit.

Arguably, one of the most important social ties in a person's life course is formed through marriage. Married people tend to be healthier than non-married people, since marriage confers economic and psychosocial resources made available by sharing finances and exchanging emotional support (Carr and Springer 2010). Scholars have also found that characteristics of marital relationships - such as marital satisfaction/quality – are positively associated with better health outcomes (Pruchno, Wilson-Genderson, and Cartwright 2009; Stokes 2016).

Marriage not only formalizes a social tie between partners, it also modifies the social ties outside of the marriage relationship (Berger and Kellner 1964). For instance, one gains "in-laws"

through marriage, and may spend more time with shared friends (as opposed to friends known only to one spouse) (Kalmijn 2003). Yet few have studied how social ties to friends and family affect health within the context of marriage. Little is known about whether a married individual's contact with friends and family is associated with the outcomes of his/her spouse (and vice versa). In most cases, marital status is simply used as a covariate when associations between social ties and health are considered (e.g., Ang 2016; Bourassa et al. 2017; Cornwell and Waite 2009). This assumes that social ties function the same way for married and non-married individuals. But married individuals may be affected not only by their own contact with friends and family, but also that of their spouse, given the unique relationship that they share (Berger and Kellner 1964).

Among heterosexual couples, varying effects by gender are also important to consider. Scholars are generally agreed that the content of both marriage (Carr and Springer 2010; Simon 2002) and social participation (Agahi and Parker 2008; Ang 2016) differ across men and women, even though they disagree on whether their beneficial effects are greater for males compared to females. Social participation (i.e., engagement and/or contact with community groups and friends/family) likely looks different for males and females in a marital relationship, since women are often expected to keep in contact with extended family on behalf of both members in the couple (di Leonardo 1987; Rosenthal 1985). In this case, it is possible that wives social participation insulate their husbands from difficult kin relationships, thus protecting their husbands' mental health (but not vice versa, since husbands do not usually engage in the emotional labor of kin-keeping).

Using a longitudinal sample of older adults in the United States, the present study explores whether the social participation of one's spouse is associated with one's own mental

health, and whether gender differences exist in these associations. I use both depressive symptoms and binge drinking as measures of mental health to account for the different ways in which men and women may express psychological distress. Overall, I find that spousal contact with friends and family can affect one's own mental health, and that within-dyad discrepancies in informal social participation can be detrimental to the mental well-being of women. These findings show that for married persons, social participation is usefully viewed through the lens of "linked lives".

Background

Linked lives and health in marriage

The life course principle of "linked lives" suggests that individual behaviors and outcomes are often affected by those of proximate others, especially those with whom one may share a close relationship, such as family members and friends. This interdependence of lives occurs at every part of the life course – relationships determine who we share key moments in life with, determine how we organize our lives, help us judge our progress in life against that of others, and more (Settersten 2015).

The marital relationship is a particularly crucial way through which the lives of individuals (and their spouses) are "linked" to each other. Married people tend to have overall better health and well-being, measured through indicators such as mortality (Staehelin et al. 2012), cardiovascular health (Wong et al. 2018), functional limitations (Hughes and Waite 2009), and mental health (Simon 2002). These associations persist even after researchers account for selection effects (i.e., adjusting for the fact that healthier people are more likely to get

married) (Carr and Springer 2010), supporting a causal interpretation for the overall health benefits gleaned from being married.

Marriage benefits health through the sharing of economic resources, the availability of psychosocial support (from each other and from extended family members), and through social control/influence mechanisms which may promote healthy behavior (Carr and Springer 2010). These mechanisms reinforce the notion that spouses' lives are "linked" – the behavior and circumstances of one spouse affects the other's health outcomes. For instance, scholars have shown that among older adults, giving/receiving of oral sex from/to one's partner affects one's own well-being, partly because it increases his/her partner's perception of the marital relationship (Liu, Shen, and Hsieh 2018). Other studies have shown that the disability of one's spouse affects one's own social relationships (Wong and Hsieh 2017), and that the loneliness of one's spouse influences one's own loneliness over time (Stokes 2016).

Many have noted that the existence of the marriage "link" itself has consequences for mental health. The traditional "sex role hypothesis" (advanced by Gove (1972)) argued that marriage was advantageous for the mental health of men but disadvantageous for women. It was thought that while men could leave domestic work to their spouses in order to pursue purpose in their paid employment, women often had to contend with the inherently stressful and frustrating duties of being a housewife (Gove and Tudor 1973). Some scholars argue that this is not true – after accounting for selection effects (into marriage) and differences in emotional expression, emotional advantages from marriage apply equally to men and women (Simon 2002; Waite and Gallagher 2000). Yet in contexts where gender inequality remains high, gender differences in mental health after marriage continue to reflect the "sex role hypothesis" (Jang et al. 2009;

Strohschein and Ram 2016), with men reaping greater mental health benefits from marriage compared to women.

Few, however, have considered gender differences in specific pathways *within* the marriage relationship through which men may derive more mental health benefits vis-à-vis women (and/or vice versa). So while research shows that women in older cohorts tended to gain more financial benefits from marriage compared to men (Light 2004), much less is known about whether any financial benefits gained will matter more for the well-being of men or women. Similarly, scholars have found that marriage increases the amount of contact with relatives and the provision of support for women (but not for men) (Kalmijn 2012) – but does contact with relatives within a marriage affect the mental well-being of wives more than that of husbands? Going a step further, do wives' contact with relatives matter more for their husband's mental well-being compared to vice versa (i.e., husbands' contact with relatives affecting their wife's mental well-being)? Understanding these within-couple dynamics can reveal specific areas where one gender may derive more benefit from the marriage relationship compared to the other.

Gender, social participation, and health

Social participation is a well-known predictor of mental health that is meaningfully altered by marriage. Married people tend to have more kin ties (and fewer non-kin ties or friends) in their networks compared to non-married people (Kalmijn 2012), and share the work of keeping in contact with these network members (Rosenthal 1985). Scholars have long explicated the health benefits of social participation for individuals, especially among older adults. Social participation has been shown to reduce mortality (Agahi and Parker 2008; Ang 2016; Thomas 2012), slow cognitive decline (Bourassa et al. 2017; Haslam et al. 2014) and

functional decline (Tomioka et al. 2017), as well as prevent the development of depressive symptoms (Croezen et al. 2015). Research suggests that social participation influences health outcomes by strengthening one's sense of social identity (Haslam et al. 2014), functioning as an antecedent to the receipt of social support, and promoting healthy behavior through social influence (Thoits 2011).

Most prior studies, however, treat social participation and its association with health outcomes solely as a function of the individuals (and their characteristics); they typically explore gender differences by treating males and females as separate individuals (e.g., Agahi and Parker 2008), instead of situating them within the larger social context (i.e., in families, in their local communities). However, the implicit statistical assumption of independence made in these cases are unlikely to hold true within the context of marital relationships, where one's relationships with family and friends are likely to affect outcomes of both the individual and his/her partner. For instance, an individual may (intentionally or unintentionally) influence his/her spouse to adopt a certain health behavior (e.g., take up a sport, consume a nutritional supplement, etc.) that was first introduced to him/her by his/her friends and family. Conflicts with family members are also likely to affect both members in the marital dyad, even if it involves only one of them directly.

This study looks at *informal* social participation – referring to the frequency of contact (or engagement) with friends and/or family members. Gender differences within marital relationships are especially pertinent here, due to the prevalence of "kin-keeping". Kin-keeping is the work done – overwhelmingly by women – on behalf of family members to keep them in touch with one another and to provide social support (Rosenthal 1985). This includes making (or hosting) visits with relatives, calls, writing letters, buying presents, organizing holiday

gatherings, and more (di Leonardo 1987). As a corollary, gender differences in informal social participation and its association with mental health may occur in at least four domains, from which hypotheses may be constructed.

First, while women still tend to have higher overall levels of informal social participation (Sander, Schupp, and Richter 2017) over the life course, there are gender differences in the way marriage *modifies* one's levels of contact with friends and family. Both men and women gain access to new network members through marriage (i.e., new friends and family), but kin-keeping within this expanded network of extended family (now including relatives from both sides of the family) limits women's pursuit of other activities beyond the home/family setting, including contact with her friends. Scholars have found that marriage tends to increase women's (but not men's) contact with relatives (although studies do not discriminate between which side of the family these relatives are from), and reduce their contact with friends to a greater extent (compared to men) (Kalmijn 2012). The traditional division of labor also meant that for most of their working lives, men typically spent more time with non-kin in the workplace, while women had more opportunities for contact with kin in the home (Stokes 2016). I do not test hypotheses in this domain of gender difference, since it results from the marriage event itself (and requires comparison between non-married and married individuals), rather than from pathways *within* the marriage relationship.

Second, kin-keeping within marriage may result in gender differences in the association between one's informal social participation and his/her mental well-being. Difficulties arising between a woman and her kin are not easily resolved by breaking off those ties, unlike friendship ties, which tend to be positive since they can be 'pruned' (Offer and Fischer 2017). In this sense, contact with friends may become more important for older women as an area for intimacy and

disclosure (Felmlee and Muraco 2009). Han and colleagues (2017) show some evidence of this – they find that neighborhood friendships were more strongly protective of depressive symptoms for wives compared to their husbands. Gender differences in the relationship between contact with family and mental health remain unclear. In some cases, kin-keeping can negatively influence health by increasing instances of role conflict, which in turn leads to higher levels of distress and more depressive symptoms (Gerstel and Gallagher 1993). This would counteract the usually positive health effects of contact with family for women, and may even result in a negative association with mental health. On the other hand, women may perform kin-keeping in order to achieve congruence with societal gender expectations; the equivalent for men is achieved by taking on the role of the breadwinner in the family (e.g., having stable employment, career advancements). Seen in this light, contact with family may be a reflection of how well women are performing in the kin-keeping role, and enhance its positive association with mental health. Researchers have found that women who were socialized into traditional gender roles (such as those from earlier-born cohorts) and conform to them by performing kin-keeping duties tend to have higher life satisfaction and psychological health outcomes (Salari and Zhang 2006). Given that this study focuses on older adults (as in Salari and Zhang (2006)), I hypothesize that:

H1a: Among married couples, the mental health of both men and women is associated with each individual's own informal social participation (i.e. actor effects).

H1b: Actor effects of informal social participation on mental health will be greater for women than for men, since social norms around kin-keeping apply mainly to women and modifies their relationships with friends and family.

Third, there may be gender differences in the association between one's informal social participation and his/her *spouse's* mental well-being. Past studies have found that psychosocial constructs such as loneliness tend to spread more easily among women compared to men (Cacioppo, Fowler, and Christakis 2009). Reasons for this are unclear, but may be because women's interactions with their friends/family are more often characterized by intimacy and disclosure, while men's interactions typically emphasize task/activity orientation (Iwasaki et al. 2002). In general, women are also more likely (than men) to discuss emotions and less likely to suppress them (Kahn and Garrison 2009). These observations suggest that wives may be more likely to be affected by and to bring emotional experiences of their friends/family from outside the home into the marital household. Further, kin-keeping may also mean that wives' contact with family reduces and prevents potential conflict between the couple and their kin members (Gerstel and Gallagher 1993), thus promoting/protecting their husbands' mental health. This dynamic suggests that women's informal social participation will be more strongly associated with husbands' mental health rather than vice versa. I hypothesize that:

H2a: Among married couples, the mental health of both men and women is associated with the informal social participation *of one's spouse* (i.e. partner effects).

H2b: Given that women may be more likely to bring emotional experiences from outside interactions into the household, partner effects of informal social participation on mental health will be greater for men than for women (i.e., wives' social participation will have a stronger association with men's mental health compared to vice versa).

Fourth, there may be gender differences in the association between within-couple discrepancies in informal social participation and mental well-being. While the differences highlighted above deal with *absolute* levels of informal social participation, discrepancies are concerned with *relative* levels of informal social participation within the couple. Scholars have long studied spousal imbalances in areas such as housework and income, showing that these imbalances can have differing impacts on the health outcomes of men and women. For instance, one recent study shows that when wives' income is relatively greater than that of their husbands, husbands (but not wives) experience increased levels of psychological distress (Syrda 2019). This is likely because women's earnings, if too great relative to their husbands, challenge the traditional social norm of the male breadwinner and this discrepancy tends to erode their husband's sense of masculinity. Analogous to the current case, Strazdins and Broom (2004) show that imbalances in emotional work affected wives' (but not husbands') psychological outcomes, because it eroded their sense of being loved within the marriage. They show, further, that the maintenance of these gender imbalances is often rationalized as beyond men's control, with women having more emotional needs. A greater discrepancy in social participation indicates that one member of the marital couple has much more contact with family/friends compared to the other. It is worth noting that kin-keeping can occur even in couples where there is no discrepancy; even if levels of contact with family are equivalent, the nature of those contacts may differ between husbands and wives (e.g., with wives doing the bulk of the emotional labor to maintain amicable relationships). Large discrepancies in informal social participation, however, are likely to point to the presence of kin-keeping. For instance, these discrepancies may indicate that the wife may be disproportionately sacrificing time with her friends to kin-keep, even as her husband spends most of his time with his friends away from the

family. In line with the theory of kin-keeping (and past results on gender imbalances in emotional work), I expect that discrepancies will typically favor husbands' mental well-being at the expense of their wives' mental well-being:

H3a: Among married couples, the mental health of both men and women is associated with imbalances in informal social participation.
H3b: The association between imbalances in informal social participation levels within dyads and mental health is greater for women than for men.

Further considerations

I account for two further considerations in this investigation of gender differences in the relationship between informal social participation and mental health. Past research has suggested that men and women are likely to express psychological distress in different ways – men are more likely to do so by externalizing problems (e.g., through substance abuse and antisocial behavior), while women turn to internalizing problems (e.g., through depression and anxiety) (Rosenfield, Vertefuille, and Mcalpine 2000). Biological differences and/or patterns of gender socialization explain these gendered expressions of distress (Rosenfield et al. 2000), which seem to remain stable over the life course (Eaton, Krueger, and Oltmanns 2011). Alcohol abuse (a externalizing problem) and depressive symptoms (an internalizing problem) are two of the most common mental disorders globally (Steel et al. 2014), with the prevalence of binge drinking among older adults rising substantially in recent years (B. H. Han et al. 2017). Scholars considering gender differences in mental health thus often study these two specific outcomes in

tandem (e.g., Horwitz, White, and Howell-White 1996; Simon 2002). In line with these prior studies, I consider both binge drinking and depressive symptoms as outcomes.

In addition, time-varying associations between social participation and mental health are important to explore, given evidence that health benefits from social participation can change with age (e.g., Ang 2018; Bourassa et al. 2017). There are several reasons for this. The socioemotional selectivity theory states that older adults begin to restrict their social networks to those more important to them as they age (Carstensen et al. 1999). This is thought to result from a conscious effort on the part of the older adult to invest in closer relationships, as a response to increasing awareness of their limited remaining lifespan. Similarly, the convoy model of social relations states that "social relations are considered important at any given point in time, yet they also build from previous experiences and hence incur additional significance over time" (Antonucci, Ajrouch, and Birditt 2013:84). Any contact with friends and/or family members (or lack thereof) is thus likely to become more salient over time, leading to stronger associations between informal social participation and mental health at later time points. Past research has also found that older adults tend to evaluate their social relationships more positively as they age (Luong et al. 2010), which may increase any mental health benefits gleaned from informal social participation. The narrowing of social networks and increased investment in intimate relationships predicted by these theories, however, may not occur solely at the individual level. Rather, spouses likely go through these processes together, occasionally making joint decisions about family gatherings and which friends to spend more time with. It is thus notable that no study, to my knowledge, has explored the time-varying associations of social participation and mental health in the context of marital dyads – e.g., how does the association between social ties of one's spouse and one's own mental health change over time? Given that both the

socioemotional selectivity theory and the convoy model of social relations suggest that contact with friends and family becomes more important for older adults as they age, I expect the association between informal social participation and mental health to strengthen in later (compared to earlier) time points in the study.

H4: Actor, partner and discrepancy effects of informal social participation on mental health grow stronger at later (compared to earlier) time points in the study.

Data

I use data from the Health and Retirement Study (HRS), a nationally representative longitudinal panel study of Americans aged 50 and above, with biennial interviews since 1992 (Sonnega et al. 2014). Specifically, I use files constructed by the Rand Corporation (RAND HRS Longitudinal File 2016 [V1], and the RAND HRS Fat files), drawing on key variables from the Psychosocial and Lifestyle Questionnaire 2006-2016 (Smith et al. 2017). Beginning in 2006, the Psychosocial and Lifestyle Questionnaire was a self-administered questionnaire left with respondents upon completion of the in-person core interview. This occurred only at alternate waves, with a random half of the sample first beginning in 2006 and the other half in 2008. Data from the Psychosocial and Lifestyle Questionnaire are thus available at four-year intervals for each household. For one half of the sample, they were completed in 2006 (Wave 1), 2010 (Wave 2), and 2014 (Wave 3). The other half completed the questionnaire in 2008 (Wave 1), and 2012 (Wave 2), and 2016 (Wave 3). I pooled data from these two halves of the sample into one, resulting in 3 waves of data for the whole sample.

I include only heterosexual couples who did not change partners throughout the study period (i.e., 2006-2016) in the analysis (only a small proportion changed partners –

approximately 2% of all couples). Both members must have been aged 50 and above at 2006. I dropped observations wherever there were missing data on variables of interest from any member of the couple, since dyadic analysis requires data from both members. This resulted in a sample size of 5121 couples, and a total of 9462 observations (mean of 1.85 observations per couple). Most of these couples seemed to be in stable relationships, with approximately 93% having been married 10 years or more at the earliest point of observation.

Variables

Depressive symptoms.

Depressive symptoms were assessed via the 8-item Center for Epidemiologic Studies Depression scale (CES-D 8), a widely used measure among older adults (Turvey, Wallace, and Herzog 1999). Respondents were asked if they felt/experienced any of the following symptoms for "much of the week": felt depressed, everything was an effort, sleep was restless, was happy (reverse coded), felt lonely, felt sad, could not get going, and enjoyed life (reverse coded). A depressive symptom score was constructed by summing up the symptoms that respondents reported feeling much of the week (range 0-8). Respondents who did not answer three or more of the eight items were treated as missing.

Binge drinking episodes.

For binge drinking, respondents in HRS were asked "In the last three months, on how many days have you had four or more drinks on one occasion? The count of days binge drinking (i.e., having 4 or more drinks on one occasion) in the last three months was used to model binge drinking as an outcome.

Informal social participation.

Informal social participation in the HRS is assessed through a series of questions eliciting frequency of contact across different modes. I consider contact with friends and family separately, to account for gendered aspects of 'kin-keeping'. Respondents were asked, "on average, how often do you do each of the following?" for each of the following activities: (a) meet up; (b) speak on the phone; and (c) write or email. Available responses included (1) three or more times a week; (2) once or twice a week; (3) once or twice a month; (4) every few months; (5) once or twice a year; and (6) less than once a year or never. The series of questions was asked repeatedly (and separately) to elicit information on contact with their (i) friends, (ii) children, and (iii) other family. Responses to these items were reverse coded and then summed across all three activities for each type of alter, resulting in three separate scores (one each for friends, children, and other family). To create an overall score for family, I then took the mean of the scores for children and other family. Possible scores for each scale ranged from 0 to 18, with higher scores indicating more contact with family/friends. These scores were centered at their grand means (i.e., mean of the whole sample) for estimation purposes.

Covariates.

Other covariates in the analysis include race (White/Black/Other), education (Less than high school/High school/Some college/College and above), household income (logged), number of chronic conditions (including high blood pressure, diabetes, cancer, lung disease, heart disease, stroke, psychiatric problems, and arthritis), and birth cohort (i.e. birth year, centered at 1935).

These covariates capture the most common factors that are associated with both informal social participation and mental health.

Analytical Strategy

For Hypotheses 1 through 4, I estimate an actor-partner interdependence model (APIM) using the framework of generalized dyadic growth curves in a Bayesian hierarchical model. Growth curves estimated with hierarchical models allow the use of unbalanced panel data, so each couple could contribute anywhere between 1-3 waves of data (the mean was 1.85 waves per couple). The growth curve framework handles unbalanced panel data by giving couples with more waves of data more weight in the analysis. The negative binomial distribution was chosen to model both measures of mental health (depressive symptoms and binge drinking episodes), since both count measures are over-dispersed. The corresponding wave number (1-3) to survey responses was used as a measure of time, and centered at baseline (Wave 1). The model for each dyad can be expressed in two equations:

$$\log(E[y_{1dt}]) = \sum_j \beta_{1j} x_{1jdt} + (\alpha_1 + \tau_{1d}) + (\gamma_1 + \nu_{1d})^* Time \quad (8)$$

$$\log(E[y_{2dt}]) = \sum_j \beta_{2j} x_{2jdt} + (\alpha_2 + \tau_{2d}) + (\gamma_2 + \nu_{2d})^* Time \quad (9)$$

Where (8) is the equation for wives' growth curves and (9) is that for husbands' growth curves. α and γ represent the population-level ("fixed") intercepts and slopes (for time), and τ and ν stand for their dyad-level ("random") components. x_{jdt} represents the value of the j^{th} independent variable for the i^{th} individual in the d^{th} dyad at time t, including respondent's own

contact with family, respondent's own contact with friends, spouse's contact with family, spouse's contact with friends, respondent's own covariates (i.e., race, education, etc.), and interactions between all aforementioned independent variables and the variable for time. β_j is the corresponding population-level slope term for the j^{th} independent variable. Relationships between group-level intercepts (τ_d) and slopes (ν_d) within dyads (i.e., linking husband's growth curves to his wife's [and vice versa]) are estimated through an unstructured 4x4 variance-covariance matrix:

$$Cov \begin{bmatrix} \tau_{1d} \\ \nu_{1d} \\ \tau_{2d} \\ \nu_{2d} \end{bmatrix} = \begin{bmatrix} \sigma^2_{\tau_1} & \sigma_{\tau_1\nu_1} & \sigma_{\tau_1\tau_2} & \sigma_{\tau_1\nu_2} \\ \sigma_{\tau_1\nu_1} & \sigma^2_{\nu_1} & \sigma_{\nu_1\tau_2} & \sigma_{\nu_1\nu_2} \\ \sigma_{\tau_1\tau_2} & \sigma_{\nu_1\tau_2} & \sigma^2_{\tau_2} & \sigma_{\tau_2\nu_2} \\ \sigma_{\tau_1\nu_2} & \sigma_{\nu_1\nu_2} & \sigma_{\tau_2\nu_2} & \sigma^2_{\nu_2} \end{bmatrix} \quad (10)$$

Where subscripts 1 and 2 on the dyad-level terms index the husband and wife comprising each dyad, respectively. The models for husbands and wives are thus joined through this covariance matrix, since studies have shown that the mental health of marital partners may be closely linked (Stokes 2016; Townsend, Miller, and Guo 2001).. I estimate the model using a Bayesian approach to aid model convergence as well as to simplify computation of uncertainty for hypothesis testing. I use only non- or weakly-informative priors. Specifically, a LKJ(1) Cholesky prior (Lewandowski, Kurowicka, and Joe 2009) was used for the covariance matrix of the dyad-level ("random") effects, the intercepts have a Student's t (-2,10) distribution with 3 degrees of freedom as priors, while the standard deviations of the dependent variable have a Student's t (0, 10) distribution with 3 degrees of freedom as priors. Population-level beta coefficients ("fixed" effects) have an improper flat prior over the real line. A Gamma (0.01,

0.01) prior was used for the scale parameter of the negative binomial model. These priors mainly help to regularize the model while influencing the results as little as possible (Bürkner 2017).

Discrepancy scores in informal social participation were used to assess Hypothesis 5 and 6. These scores were constructed by subtracting the wife's score from the husband's score for each member of the dyad, and then taking its absolute value (Kenny, Kashy, and Cook 2006). A higher discrepancy score indicates higher intra-dyad dissimilarity in informal social participation. Including them in the dyadic growth curves results in a "cross-level" hybrid model, where dyad-level characteristics/predictors (e.g., contrasts) are used to model individual-level outcomes (Wickham and Macia 2018). Following the advice of Kenny and colleagues (2006), individuals' own and partner's informal social participation are kept in the model as "main effects", since discrepancy scores can be thought of as a special kind of "interaction" between actor and partner variables.

R-hat values and trace plots showed that all models displayed good convergence. Posterior predictive checks also showed that the model predicted the observed data well. All models were estimated using the brms package in R (Bürkner 2017), which relies on Stan to execute the Markov chain Monte Carlo sampling algorithm.

As part of robustness checking, I excluded observations from couples contributing less than two waves of data (~23% of observations), but this produced largely similar results. While some coefficients did become statistically nonsignificant as a result of the reduced sample size, their direction and magnitude remained consistent with the current model. I also conducted two checks to account for selection out of marriage during the study period. First, I excluded couples for whom the length of marriage (assessed at first entry into the sample) was less than 10 years (~7%). Second, I included length of marriage as a variable in the model. In both cases, findings

were virtually the same, even though the sample size was reduced due to missingness in the length of marriage variable (~3%). As for possible confounders, I tested models including extraversion and marital quality as covariates, but this did not change the substantive findings on associations between informal social participation and health. The current model specification (i.e., without these covariates) was thus retained for parsimony.

Results

The characteristics of the sample are described in Table 6. A majority of the sample was White and had at least high school education. On average, respondents were born in 1946, with husbands slightly older than wives. Congruent with what past studies have found, wives in the sample experience more depressive symptoms but have fewer binge drinking episodes, compared to husbands. Wives also have more contact with both family and friends, compared to husbands.

Results from models predicting depressive symptoms

Dyad-level estimates from APIM growth curves of depressive symptoms provide evidence for within-couple interdependency. For instance, the correlation between husbands' and wives' intercepts ($\rho_{\tau_1\tau_2}$) was 0.33 (95% CI: [0.26, 0.40]), and the correlation between their slopes ($\rho_{\nu_1\nu_2}$) was 0.73 (95% CI: [0.13, 0.98]). Other dyad-level estimates (e.g., correlation between husbands' intercept and slope, or between husbands' intercept and wives' slope) are not reported here for parsimony (but are available upon request), given they are not the key focus of this paper. The quantities show that the mental health of husbands and wives are tightly linked to each other over time – models that do not account for these interdependence may overestimate the effects of spousal characteristics on depressive symptoms.

Table 7 displays the population-level estimates from APIM growth curves of depressive symptoms. In general, estimates for the intercept may be interpreted as time-invariant components of the association between predictors and outcomes, while estimates of the slope represent the time-varying components of these associations. Variables assessing informal social participation are of main interest here.

Actor effects show that contact with friends and family are associated with lower levels of depressive symptoms for both wives and husbands in general, even though the effect of contact with family is statistically non-significant for husbands. A one standard deviation (SD) increase in contact with friends (~3.80 points) is associated with a reduction in the incidence of depressive symptoms by approximately 7 percent (95% CI: [3%, 12%]) for wives, and 10 percent (95% CI: [5%, 14%]) for men. These actor effects do not seem to significantly vary over time. Figure 8, panels (a) and (b) show graphically how these associations change over time for husbands and wives. Further, I compute (using MCMC samples) the intra-dyad difference (wives minus husbands) between actor effects (Figure 8, panels c and d) and find no evidence to support the existence of gender difference. These results generally align with the findings of past studies showing that informal social participation is associated with fewer depressive symptoms for both men and women (Ang 2018; Croezen et al. 2015).

Partner effects on depressive symptoms show a slightly different pattern compared to actor effects. Men's contact with friends has a negative association (β = -0.015, 95% CI: [-0.028, -0.001]) with their wives' depressive symptoms, and this partner effect does not seem to vary significantly over time. This means that a one SD increase in husbands' contact with friends is associated with about a 5 percent (95% CI: [1%, 10%]) reduction in the incidence rate of their wives' depressive symptoms. For both men and women, spousal contact with family is not

significantly associated with depressive symptoms at baseline. However, this association becomes significantly more negative over time, culminating in a significant negative association by the third time point (i.e., the sixth year in the study) (Figure 9, panel a) for both husbands and wives. I find no evidence of gender difference in partner effects here (Figure 9, panels c and d).

Results from the model with discrepancy scores is shown in Table 8. Since actor and partner effects here are meant primarily as covariates in the model, I focus on coefficients from discrepancy scores. Two observations are of note here. First, discrepancy scores for contact with family are not associated with depressive symptoms for wives at baseline, but this association grows over time, becoming statistically significant in the two later time points (Figure 10, panel a). At the third time point, a one SD increase in the discrepancy score in contact with family (~2.11 points) is associated with a 7 percent (95% CI: [2%, 13%]) increase in the incidence rate of wives' depressive symptoms. Second, the discrepancy score for contact with friends has a significant *positive* association with depressive symptoms for wives, but this association does not seem to vary over time. This means that when there is intra-dyad discordance in contact with friends, wives tend to experience more depressive symptoms. A one SD increase in the discrepancy score in contact with friends (~2.92 points) is associated with about a 5 percent (95% CI: [1%, 10%]) increase in the incidence rate of wives' depressive symptoms. A gender difference can be observed here (Figure 10, panel d). Interestingly, post-hoc analysis using a categorical variable (instead of a continuous score) to represent discrepancies according to which member of the couple had higher levels of contact (i.e., husband, wife, or both similar) showed that these discrepancy effects were agnostic as to member in the marital dyad had more contact. In other words, discrepancies in contact with friends (and family, at later time points) were

positively associated with depressive symptoms for wives, regardless of whether the husband or the wife had more contact with their friends.

Results from models predicting binge drinking

Dyad-level estimates from APIM models also show provide evidence for within-couple concordance in binge drinking trajectories. The correlation between husbands' and wives' intercepts ($\rho_{\tau_1\tau_2}$) was 0.62 (95% CI: [0.55, 0.68]), while the correlation between their slopes ($\rho_{\nu_1\nu_2}$) was 0.70 (95% CI: [0.24, 0.96]).

Actor effects here are apparent only for men (Table 9). Statistically speaking, however, estimates for the difference in men and women's actor effects are not reliably different from zero (Figure 11, panel c and d). For husbands, a one SD increase in contact with family (~3.07 points) reduces the incidence of binge drinking by approximately 17 percent (95% CI: [1%, 30%]), but a one SD increase in contact with friends increases their incidence of binge drinking by about 21 percent (95% CI: [3%, 43%]). Drinking alcohol is a primarily social activity for older adults (Kelly et al. 2018), so it is unsurprising that more contact with friends is associated with more binge drinking episodes. Some studies have found that social participation (especially contact with male friends) is positively associated with both overall alcohol use and heavy/risky drinking (Kelly et al. 2018; Seid 2016), even though others suggest that socially isolated older adults tend to drink more (Choi and DiNitto 2011). What is perhaps novel here is that more contact with family is associated with fewer binge drinking episodes among men. Given that older adults' drinking behaviors are strongly influenced by their immediate social contexts (Burruss, Sacco, and Smith 2015), it may be that older men are generally more restrained (in alcohol use) around

family members compared to settings where only friends are present. Spending more time with family members may thus lead to fewer episodes of binge drinking.

Where partner effects are concerned, wives' binge drinking is positively associated with their husband's contact with friends. A one SD increase in their husband's contact with friends increases the incidence of wives' binge drinking by about 29% (95% CI: [1%, 64%]). There is some evidence for a gender difference in partner effects from contact with friends, given that 95% credible intervals for the difference in effects do not contain zero for the first two time points (Figure 12, panel d). This partner effect does not seem to vary across time.

Finally, discrepancy scores for contact with friends and family do not show any significant associations (Table 10) with episodes of binge drinking, and gender differences were not found (Figure 13, panels c and d).

Discussion

Using dyads of older adults, this chapter explores the association of informal social participation with mental health in the context of "linked lives". The HRS' large sample size and responses collected over 10 years are an inherent strength of the data. Unlike past studies that treat observations as independent, dyadic growth curves are used to allow for within-couple interdependencies in mental health outcomes. Both depressive symptoms and binge drinking are considered, since these are thought to be gendered expressions of poor mental health. Overall, results provide evidence that couple-level dynamics in social participation and mental health are important to consider. The informal social participation of one's spouse (both absolute and relative levels) is associated with one's own mental health. Evidence for gender differences in actor and partner effects, however, is not strong. I discuss these findings in more detail below.

Estimates from dyadic models suggest that *time matters* when considering the effect of spousal social participation on depressive symptoms. Partner effects of contact with family on depressive symptoms seemed to emerge only over time. A consistent pattern is observed for the association between imbalances in contact with family and depressive symptoms (i.e., discrepancy effects) for women. As highlighted earlier, both the socioemotional selectivity theory (Carstensen et al. 1999) and the convoy model of social relations (Antonucci et al. 2013) emphasize that relationships with family members become more important over time. However, existing studies mainly apply these theories to individuals, rather than couples or dyads. It is therefore interesting that the time-varying effect in this study is observed for spousal contact with family, rather than one's own contact with family. One plausible explanation for this is that alongside their own desires to prioritize familial relations, older adults' expectations of their spouse's contact with family also grow over time. Their own mental health may then become more dependent on their spouse's contact with family members. The current study provides impetus for future studies to explore these types of couple dynamics in social participation and mental health.

A different dynamic for binge drinking is observed. Spousal social participation is related to more episodes of binge drinking. For women, binge drinking is associated with their husbands' contact with friends. A possible explanation may be that the association is capturing situations where both members of the couple spend time with the husband's friends and are encouraged to drink more. Qualitative research has shown that given the social nature of drinking among older adults, individuals feel compelled to align with their companions' drinking behavior (Bareham et al. 2018). This can either help to restrict or encourage heavy drinking, depending on one's drinking companions. Friends of husbands may tend to be heavier drinkers

than friends of wives, thus encouraging the spouse to drink more in such settings. This explanation assumes, however, that women do not consider and/or report such situations as consisting of their own contact with friends. In other words, it assumes that women do not consider their husband's friends as their own friends.

In addition, partner effects for both depressive symptoms and binge drinking are substantively large. One intuitive way to evaluate the substantive size of these associations is to compare them to actor effects in the sample, since past studies have repeatedly concluded that individual-level effects from informal social participation are crucial for mental health outcomes. For instance, among females, partner effects for depressive symptoms at the third time point (i.e., the 6th year) were approximately half the size of baseline actor effects (Partner to actor effects ratio = 0.640, 95% CI: [0.001, 1.602]) and larger than actor effects at the same time point (Partner to actor effects ratio = 1.434, 95% CI: [-9.775, 13.240]). This suggests that partner effects in informal social participation are as important to investigate as actor effects (which have been the focus of past studies), especially among married couples.

Prior studies have long acknowledged that the *absence* of partners can affect informal social participation and health. Widowhood can negatively impact the mental health of older adults because social networks shrink after the loss of a spouse (Collins 2018), even though some may adapt to this situation by increasing their informal social participation (Utz et al. 2002). However, much less is known about the way in which the *presence* of living spouses and their social relationships (i.e., social participation, social support, etc.) can affect one's own social relationships and health outcomes. The current study demonstrates the principle of "linked lives" and shows that spouses are an important part of the relationship between social participation and

mental health, both in terms of absolute and relative levels of participation. Other types of dyads, such as caregiver-care recipient dyads or parent-child dyads may also be important to investigate.

Gender differences were not as readily apparent as expected. I do not find any evidence for gender differences in actor effects for either depressive symptoms or binge drinking, unlike what some studies using individual-level (as opposed to dyadic) data have suggested (e.g., Agahi and Parker 2008; Li et al. 2011). It seems that the mental health of both husbands and wives are broadly associated to their own informal social participation in similar ways. However, I find gender differences in partner effects in two places. First, as highlighted above, women's binge drinking is associated with their husbands' contact with friends, but their contact with their own friends does not affect their husband's binge drinking in the same way. Second, within-dyad imbalances in contact with friends are more strongly associated with wives' (vs. husbands') mental health. The exact reasons for this pattern are yet unclear, but these results suggest that women are generally more sensitive to some of their husbands' behaviors compared to vice versa. The findings also provide context to the "sex role hypothesis" – women's mental health may seem to benefit less from the overall marriage relationship in situations where couple dynamics in certain areas are not ideal. For instance, in dyads where there are no discrepancies in contact with friends, men and women are more likely to benefit equally from increased informal social participation. However, where discrepancies are large, wives may end up benefitting less from their informal social participation. This is because the detrimental effects of discrepancies may 'cancel out' the salubrious effects of contact with friends for wives, but not for their husbands. While this does not constitute definitive evidence for or against the "sex role hypothesis", the findings highlight the need to consider the specific pathways leading to gender differences in net mental health benefits/costs from marriage.

I find some evidence for the detrimental effects of kin-keeping on mental health. While both husbands and wives similarly benefit from contact with family (both own and spousal contact), within-dyad discrepancies in contact with family is associated with more depressive symptoms among women at later time points. This means that the mental health of wives is likely to suffer when one member of the dyad has more contact with family compared to the other. Just like partner effects for contact with family, the element of time matters here, suggesting that imbalances are likely to be increasingly detrimental to women's mental health in the long run. These results contradict those of previous studies suggesting that women socialized into traditional gender roles (i.e., older adults) may derive mental health benefits from kin-keeping (Salari and Zhang 2006). This underscores the need to consider dyads when making assertions about kin-keeping, since relative levels of contact with family within the couple and absolute levels of contact with family may be associated with mental health in distinct (and/or opposite) ways. Mental health benefits gained from having more contact with family (whether through one's own contact or spousal contact) may therefore be negated by large imbalances in familial contact within couples. It remains uncertain whether discrepancies in contact with family members affect women differently than men. While discrepancy effects for husbands' mental health are not significantly different from zero, there was no evidence for a gender difference in discrepancy effects.

A few implications follow. Many have sought to increase social participation in older adults via interventions (Raymond et al. 2013), since social participation is a key modifiable determinant of health outcomes in later life. Most of these interventions focus solely on individuals as if they were completely independent. I have found here that the social participation and mental health of individuals are in fact linked – the informal social participation

of just one member in a spousal dyad can influence the other. This highlights the 'hidden' efficacy of social participation, since those who share a relationship with the target of intervention are also likely to benefit as a result. It also suggests that interventions targeting "linked lives" (e.g., marital dyads, caregiver-care recipient dyads) are likely to yield even greater health benefits. For greater efficacy, these interventions should focus not only on increasing social participation for both members of a given dyad, but also in reducing discrepancies between them. Not all of these effects are positive, however. I find that husbands' contact with friends is associated with increased binge drinking for both themselves and their wives. This presents a quandary given that alcohol consumption is a way in which older adults may socialize, and discouraging contact with friends is likely to have negative effects on well-being in other areas (Kelly et al. 2018). One possible strategy is to promote both contact with friends *and with family* simultaneously, since contact with family is negatively associated with binge drinking (and may cancel out the detrimental effects of contact with friends).

Several limitations of the current study should be noted. First, the terms "actor effects", "partner effects", and "discrepancy effects" were used following the conventions of the APIM model, but associations established in this study cannot be interpreted causally. I have used dyadic growth curves to describe associations over time, but the temporal patterns cannot be used to allege causality. That said, many past studies have already gathered evidence in support of a causal interpretation for actor effects from informal social participation (e.g., Ang 2016; Bourassa et al. 2017). A model allowing for causal interpretation of partner effects, however, becomes tricky to justify and estimate. A selection model for partner effects of informal social participation should account for assortative mating and other dyadic processes. I have not attempted to solve this methodological puzzle here, but it is a fruitful area of research given the

increasing availability of dyadic data. Second, it is not clear how the measures of informal social participation used in the HRS are capturing couple-level contact with friends and family. For instance, a respondent may or may not consider spending time with his/her spouse's friends as their part of their own "contact with friends". Future research should consider using novel and more incisive measures to better assess how individuals view interactions with their spouses' friends and how they are perceived. Third, the sample represents older adults who may have been socialized into more traditional gender roles. Gender differences found here thus may not be generalizable to younger populations or cohorts, whose characteristics within marriage may be differentially associated with mental health given changes in gender equality over time (Simon 2002). Scholars should also seek to clarify if similar associations can be found in cohabiting relationships. Finally, findings here relate to heterosexual married couples, but the way that informal social participation may vary in same-sex couples since mechanisms such as social control are likely to operate differently (Umberson, Donnelly, and Pollitt 2018). In this cohort of older adults, however, data from same-sex couples were relatively few (~2% with available dyadic data in the HRS sample).

In sum, this study establishes a link between spousal informal social participation and mental health; it also provides some evidence for gender differences in partner and discrepancy effects. Findings underscore the need to consider "linked lives" when assessing the benefits of social participation (and "social connectedness" in general) for health outcomes, and caution against making conclusions about kin-keeping when only data from one member of the dyad is available. Apart from ascertaining causality and testing possible mechanisms through which couple characteristics may affect mental health, it will also be fruitful for future studies to

examine other types of “linked lives” (e.g., parent-child, caregiver-care recipient) through which the social participation of one member may influence the health of the other.

Table 6: Descriptive statistics of the sample at baseline (N=5121)

Variable	Overall Weighted % or Mean (SD)	Husbands Weighted % or Mean (SD)	Wives Weighted % or Mean (SD)	Difference *p*-value[b]
Depressive symptoms	1.11 (1.74)	1.01 (1.63)	1.20 (1.83)	< 0.001
Days spent binge drinking	1.52 (8.57)	2.49 (11.23)	0.56 (4.34)	< 0.001
Contact with family[a]	7.74 (3.07)	7.19 (2.98)	8.21 (3.18)	< 0.001
Contact with friends[a]	7.94 (3.80)	7.41 (3.77)	8.57 (3.79)	< 0.001
Discrepancy score (family)	2.59 (2.11)	-	-	-
Discrepancy score (friends)	3.51 (2.92)	-	-	-
Race				
White	89.23	88.81	89.66	0.31
Black	5.38	5.48	5.28	0.75
Other	5.38	5.71	5.06	0.24
Education				
Less than high school	11.63	12.77	10.48	< 0.001
High school	33.26	30.86	35.67	< 0.001
Some college	25.00	23.29	26.71	< 0.001
College and above	30.11	33.07	27.15	< 0.001
Household income (logged)	11.02 (0.96)	-	-	-
Number of chronic conditions	1.77 (1.34)	1.75 (1.40)	1.61 (1.30)	< 0.001
Birth cohort[a]	1946	1944	1947	< 0.001

Notes: Couples could enter the analytical sample at any wave. Descriptive statistics presented here are calculated based on the earliest available wave from each couple (Wave 1 – 3351 couples; Wave 2 – 1208 couples; Wave 3 – 562 couples). Household level weights are used to provide weighted statistics. [a]Figures reported here are before centering, rounded to the nearest integer. Range is 0-18, with higher scores indicating more contact. [b]*p*-values were calculated using two-tailed t-tests for paired samples.

Table 7: Coefficients from dyadic growth curve models predicting depressive symptoms

	Husbands		**Wives**	
Variable	Intercept	Slope	Intercept	Slope
Own contact with family	-0.013	-0.003	-0.031*	0.009
Own contact with friends	-0.027*	-0.005	-0.020*	-0.004
Spousal contact with family	0.005	-0.016*	0.016	-0.017*
Spousal contact with friends	-0.012	0.010	-0.015*	0.004
Race				
White	Ref.	Ref.	Ref.	Ref.
Black	0.265*	0.082	0.066	0.056
Other	0.260*	-0.008	0.082	0.116
Education				
Less than high school	Ref.	Ref.	Ref.	Ref.
High school	-0.431*	0.092	-0.395*	-0.017
Some college	-0.473*	0.026	-0.515*	-0.000
College and above	-0.772*	0.092	-0.627*	-0.083
Household income (logged)	-0.105*	0.020	-0.127*	0.041*
Number of chronic conditions	0.262*	0.003	0.286*	0.002
Birth cohort	0.025*	-0.005*	0.020*	-0.001
Time (in 2-year units)	0.342	-0.420*	0.783*	-0.528*

Notes: *Indicates 95% credible interval does not include zero.

Table 8: Coefficients from dyadic growth curve models predicting depressive symptoms with discrepancy score

	Husbands		Wives	
Variable	Intercept	Slope	Intercept	Slope
Own contact with family	-0.005	-0.005	-0.033*	0.006
Own contact with friends	-0.029*	-0.006	-0.024*	-0.002
Spousal contact with family	-0.002	-0.013	0.018	-0.015*
Spousal contact with friends	-0.012	0.011*	-0.010	0.002
Discrepancy score (family)	0.023	-0.007	0.006	0.014*
Discrepancy score (friends)	-0.005	-0.003	0.018*	-0.009
Race				
White	Ref.	Ref.	Ref.	Ref.
Black	0.260*	0.087	0.074	0.046
Other	0.260*	-0.005	0.082	0.114
Education				
Less than high school	Ref.	Ref.	Ref.	Ref.
High school	-0.432*	0.096*	-0.391*	-0.021
Some college	-0.474*	0.029	-0.517*	-0.004
College and above	-0.771*	0.093	-0.624*	-0.088
Household income (logged)	-0.106*	0.021	-0.125*	0.040*
Number of chronic conditions	0.260*	0.003	0.283*	0.005
Birth cohort	0.025*	-0.005*	0.020	-0.001
Time (in 2-year units)	0.326	-0.407*	0.706*	-0.537*

Notes: *Indicates 95% credible interval does not include zero.

Table 9: Coefficients from dyadic growth curve models predicting number of binge drinking episodes

	Husbands		Wives	
Variable	Intercept	Slope	Intercept	Slope
Own contact with family	-0.062*	0.025	-0.024	0.003
Own contact with friends	0.050*	0.006	0.036	-0.005
Spousal contact with family	0.053	-0.011	-0.007	-0.010
Spousal contact with friends	-0.032	0.023	0.064*	-0.004
Race				
White	Ref.	Ref.	Ref.	Ref.
Black	-0.826*	-0.101	-0.098	-0.645
Other	-0.678	0.508*	-0.636	0.163
Education				
Less than high school	Ref.	Ref.	Ref.	Ref.
High school	0.086	0.035	0.465	0.143
Some college	-0.111	0.140	0.159	0.455
College and above	-0.317	0.075	0.197	0.233
Household income (logged)	0.087	-0.011	0.205	0.118
Number of chronic conditions	-0.109	-0.057	-0.322*	0.083
Birth cohort	0.114	-0.006	0.112*	-0.001
Time (in 2-year units)	-4.922*	0.118	-9.210*	-1.514

Notes: *Indicates 95% credible interval does not include zero.

Table 10: Coefficients from dyadic growth curve models predicting number of binge drinking episodes with discrepancy score

	Husbands		**Wives**	
Variable	Intercept	Slope	Intercept	Slope
Own contact with family	-0.047	0.014	0.002	0.003
Own contact with friends	0.057*	0.002	0.006	-0.003
Spousal contact with family	0.038	-0.001	-0.022	-0.013
Spousal contact with friends	-0.037	0.027	0.064	-0.007
Discrepancy score (family)	0.047	-0.040	0.006	-0.003
Discrepancy score (friends)	0.022	-0.013	0.002	-0.015
Race				
White	Ref.	Ref.	Ref.	Ref.
Black	-0.811*	-0.112	-0.113	-0.641
Other	-0.695	0.517*	-0.641	0.164
Education				
Less than high school	Ref.	Ref.	Ref.	Ref.
High school	0.069	0.037	0.459	0.147
Some college	-0.133	0.146	0.150	0.458
College and above	-0.314	0.065	0.193	0.230
Household income (logged)	0.089	-0.012	0.210	0.118
Number of chronic conditions	-0.118	-0.052	-0.322*	0.084
Birth cohort	0.112*	-0.005	0.112*	-0.001
Time (in 2-year units)	-5.077*	0.241	-9.302*	-1.469

Notes: *Indicates 95% credible interval does not include zero.

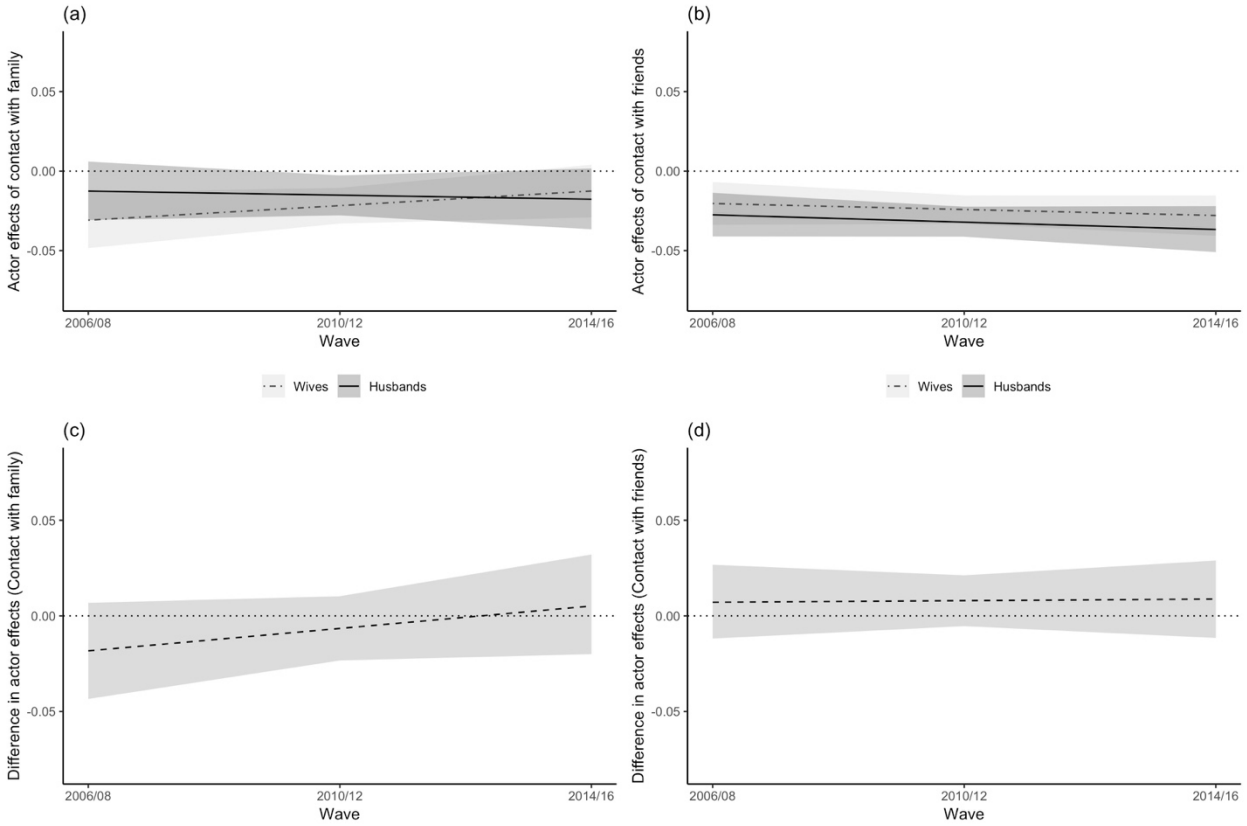

Figure 8: Actor effects of informal social participation on number of depressive symptoms. Shaded regions demarcate 95% credible intervals.

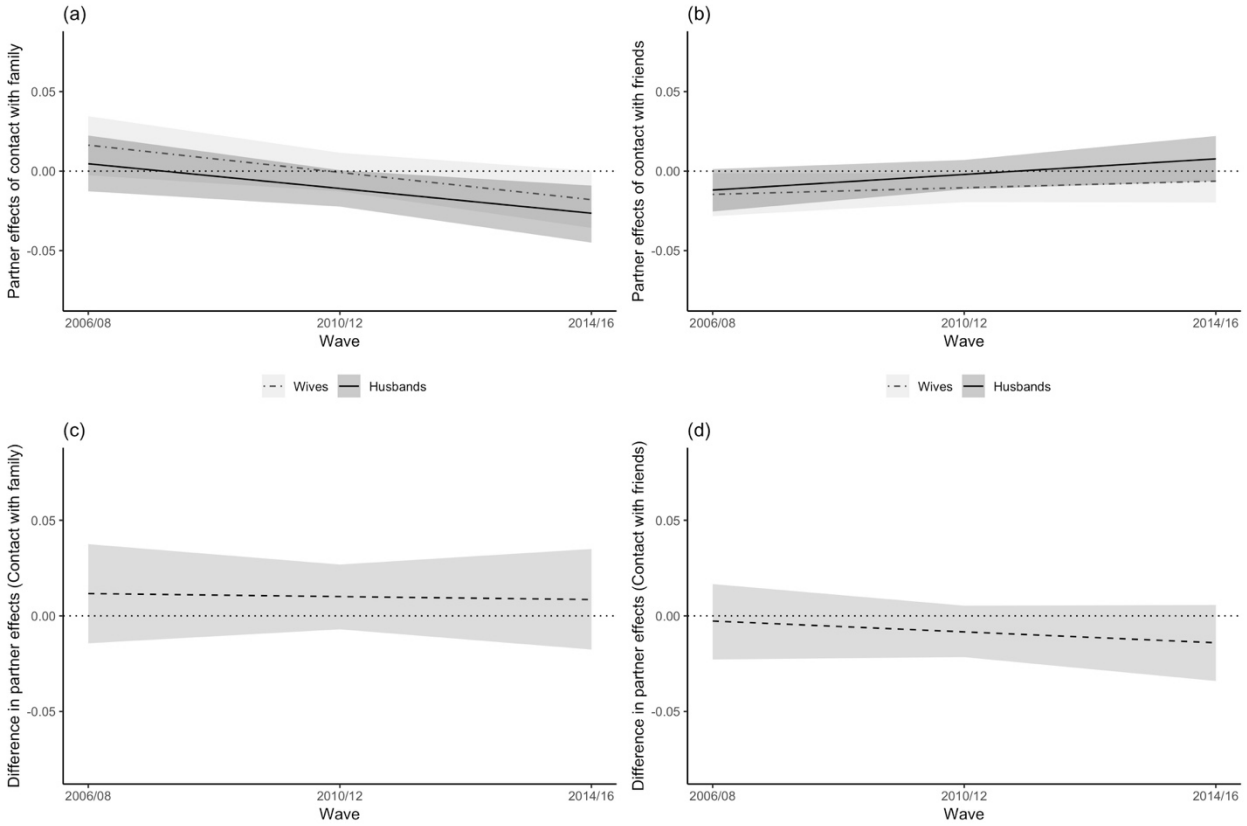

Figure 9: Partner effects of informal social participation on number of depressive symptoms. Shaded regions demarcate 95% credible intervals.

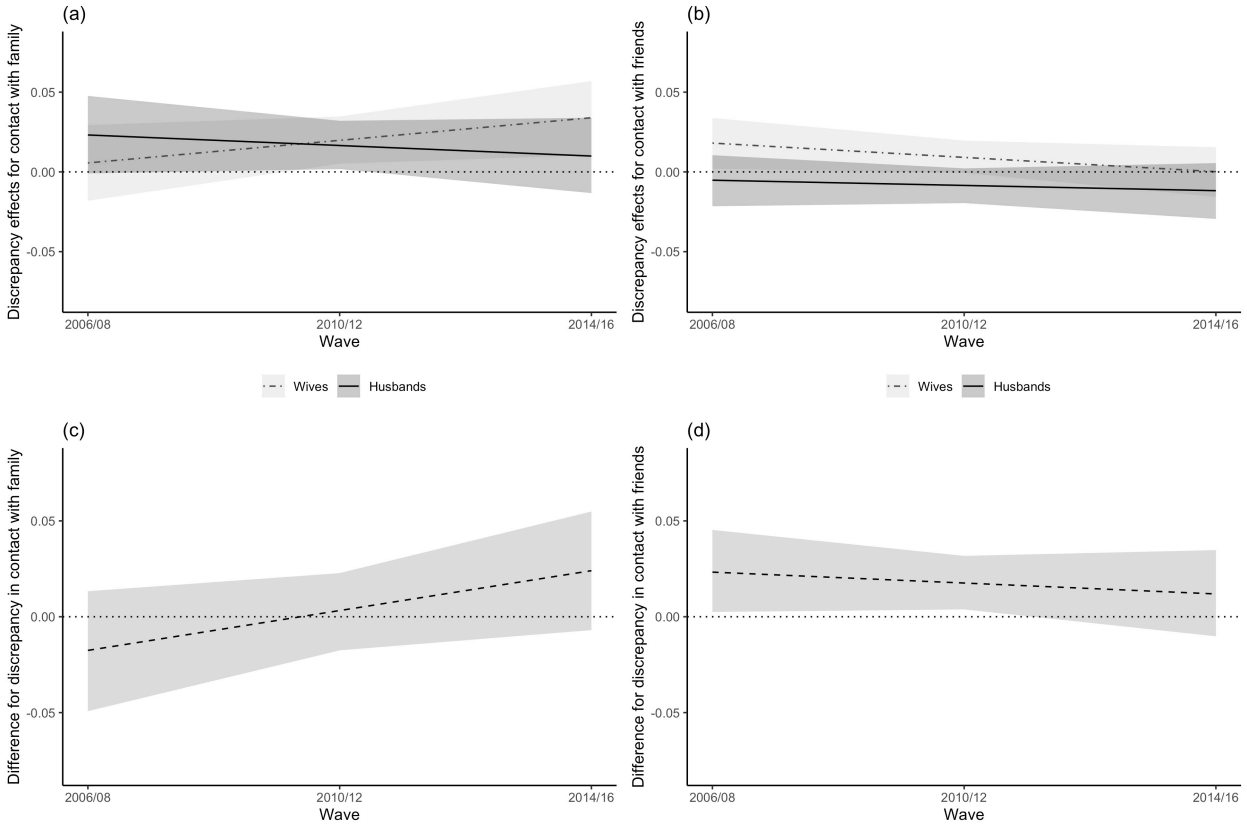

Figure 10: Discrepancy effects of informal social participation on number of depressive symptoms. Shaded regions demarcate 95% credible intervals.

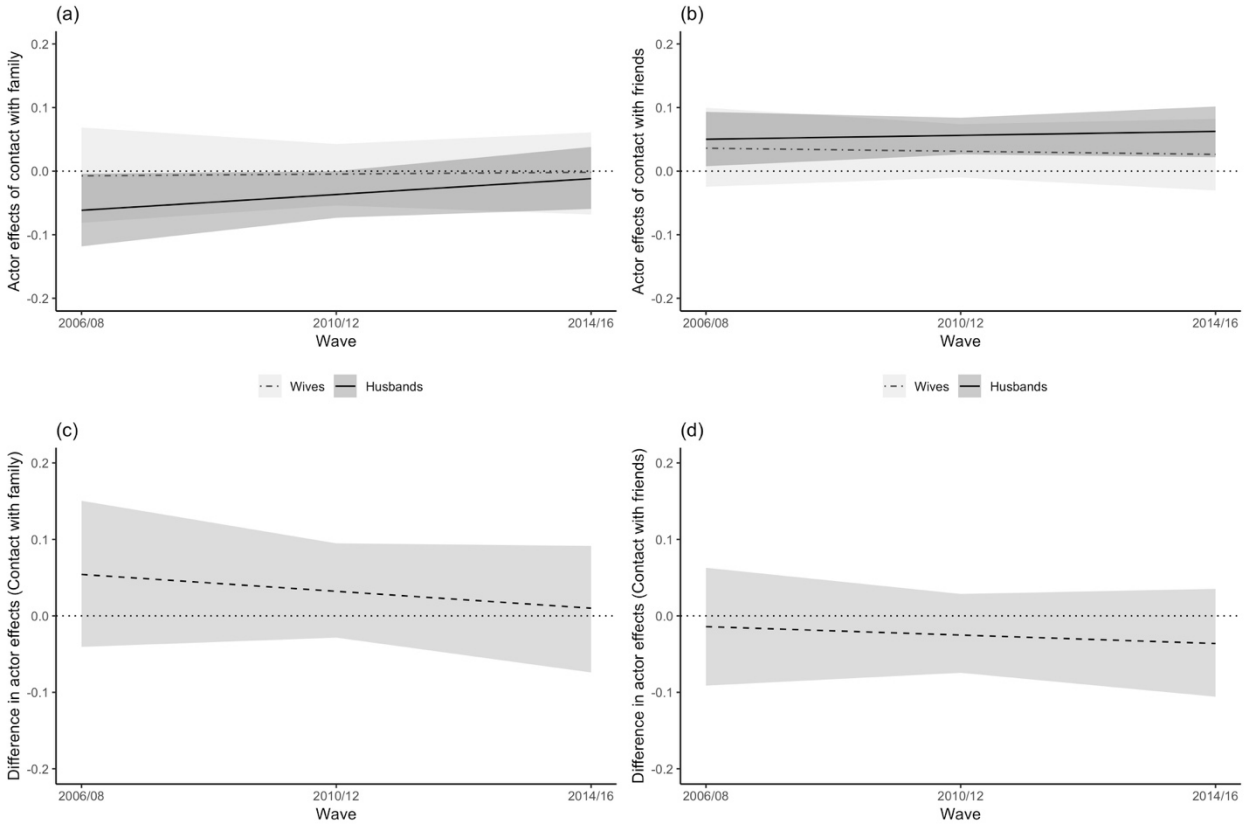

Figure 11: Actor effects of informal social participation on number of binge drinking episodes. Shaded regions demarcate 95% credible intervals.

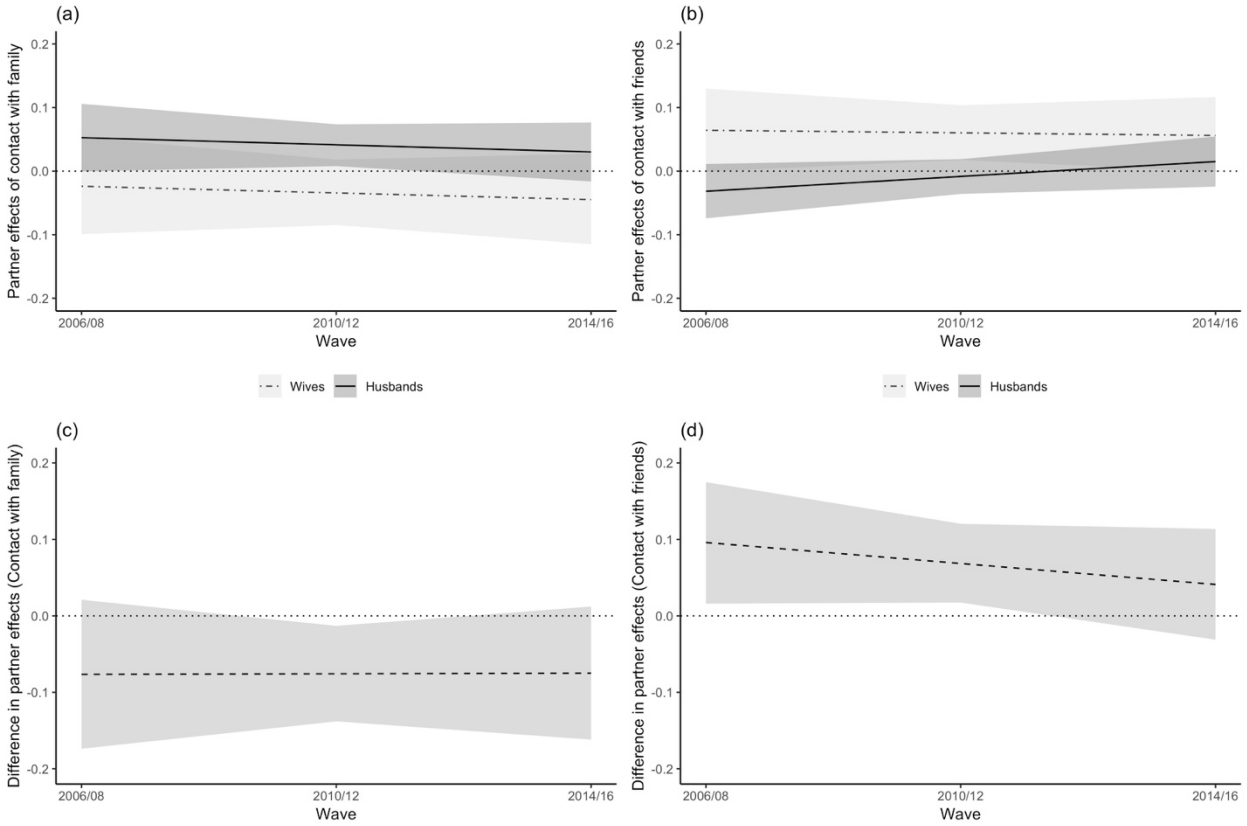

Figure 12: Partner effects of informal social participation on number of binge drinking episodes. Shaded regions demarcate 95% credible intervals.

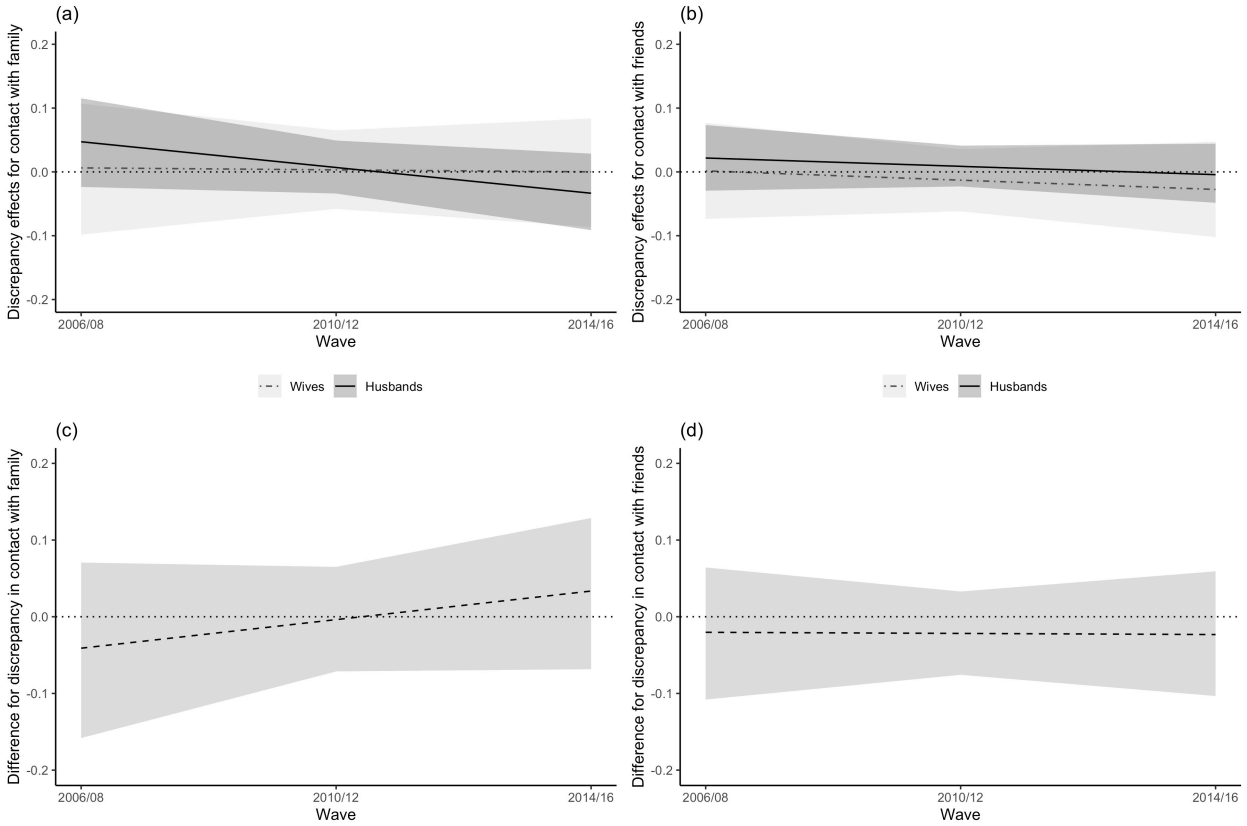

Figure 13: Discrepancy effects of informal social participation on number of binge drinking episodes. Shaded regions demarcate 95% credible intervals.

CHAPTER 5

Conclusion

This dissertation extends past studies on social participation and health by applying the life course perspective. In a series of empirical analyses using large, nationally representative surveys, the three foregoing chapters (Chapters 2-4) engage with life course principles (Elder 1998) by (1) examining how social participation varies over age and cohort; (2) establishing how the association between social participation and health changes with age; and (3) investigating how social participation and health is associated in the context of marital dyads. In this section, I summarize these contributions to the literature.

Chapter 2 described trends in social participation over the life course by age and cohort in sample of American adults born 1962 and earlier. Given that most prior studies have relied on repeated cross-section data, a key strength of this study is the ability to estimate (and separate) age and cohort effects through the use of an accelerated longitudinal (or cohort sequential) design. The analyses in this chapter brought together two usually separate strands of the larger literature on social connectedness (a term encompassing various aspects of social life, e.g., size of social networks, quality of social support, social participation etc.) – (1) trajectories of social connectedness as individuals age, and (2) overall trends in social connectedness over the past few decades. Using social participation as a measure of social connectedness, I make a contribution to each of these strands.

First, past studies have long debated about whether individuals gradually retreat from society as they age (Cumming and Henry 1961), or if they continue to stay active throughout their later years (Atchley 1989). My analysis of data from the Americans' Changing Lives survey shows a more nuanced picture of "compensation". Rather than either dropping or maintaining all their formal (e.g., attendance and engagement in community groups and organizations) and informal social participation activities (e.g., gatherings with family and friends) as they age, individuals seem to experience a simultaneous increase in formal social activities and decrease in informal social activities. This suggests that individuals change the composition of their social activities over time. To the best of my knowledge, this study is also the first longitudinal study to describe trajectories of social participation starting from age 25. Prior research on age-related changes in social participation has typically relied on data from later life only (i.e., age 50 onwards), and cannot directly show how social participation in old age compares to that of the same individuals when they were younger. I apply the life course principle of *life-span development*, and contextualize social participation during each part of the life course (e.g., young adulthood, mid-life, old age) within the larger context of its entirety.

Second, while prior work pointed to a decline in social connectedness (Putnam 2000), I find no evidence for a decrease in social participation in later-born cohorts (compared to earlier-born cohorts). In fact, results show an increase in formal social participation in later-born cohorts. This directly contradicts the accounts of Putnam (2000:275), who alleges 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". These findings on cohort changes in social participation are novel, and add to previous work suggesting that anxiety around societal declines in social connectedness is likely uncalled

for (Fischer 2011; Wang and Wellman 2010) – people are engaging with formal organizations and keeping in contact with friends and family as often as before.

Chapter 3 contributes to the literature by addressing the question of whether the association between social participation and health varies with age. While studies find that social participation is associated with better health outcomes (e.g., Agahi and Parker 2008; Ang 2016; Bourassa et al. 2017) through pathways such as stress-buffering or promoting healthy behavior through social control (Thoits 2011), few studies look at age as a moderator of this relationship. The principle of *timing in lives*, however, suggests that social participation may have differing associations with health depending on when it occurs in the life course. One reason for this is that while older adults are thought to restrict their networks to a few members in search of emotional intimacy, younger members tend to seek an expansion of their networks for instrumental gain (Carstensen et al. 1999). The pathways through which social participation affects health therefore are likely to vary by age.

Findings from analyses in Chapter 3 show that, in general, the association between social participation and health (assessed using the number of chronic illnesses, and the severity of depressive symptoms) does not vary with age. This finding challenges the typical assumption that social participation matters more for older adults, who are often seen to be at greater risk of social isolation and most deserving of attention (Landeiro et al. 2017; Malcolm, Frost, and Cowie 2019). However, there is one important exception – the association between depressive symptoms and formal social participation grew stronger with age among men (but not among women). This finding may reflect the fact that men's sense of self and identity are often rooted in their work and occupational status (Gradman 2019). Formal social participation may therefore become more important as men age into later life, by helping to fill role absences and ensuring

continuity in the midst of the transition out of employment (Goll et al. 2015). Chapter 3 thus contributes to the large body of literature on the association between social participation and health by specifically highlighting how *timing* in the life course can moderate this relationship.

Chapter 4 contributes to the literature by examining how the association between social participation and health operates within the marital relationship. Existing studies usually see social participation as the characteristic of an individual, failing to consider inter-dependencies in social participation and health within intimate relationships. Given the intimate nature of a marriage relationship however, married individuals may be affected not only by their own contact with friends and family, but also that of their spouse. For instance, scholars have highlighted that marriage often improves health outcomes for both partners through social control – i.e., spouses monitor each other's health behaviors (Carr and Springer 2010). Social participation is thought to influence health through a similar pathway (Thoits 2011), where individuals may be influenced by his/her friends and family to adopt certain health behaviors (e.g., exercising regularly, participating in a sport). What this means is that it is possible for one spouse to adopt health behaviors as a result of social participation, and in turn influence his/her spouse to adopt those same behaviors. This demonstrates that the social participation and health of spouses are inextricably "linked" to each other. This is encapsulated by the life course principle of *linked lives*, which is empirically explored in Chapter 4.

Analyses in Chapter 4 provide evidence for a link between spousal social participation and one's own mental health (i.e., partner effects), after accounting for interdependencies in mental health between spouses. For depressive symptoms, spousal contact with family on depressive symptoms seemed to emerge only over time. The association between within-dyad discrepancies in contact with family and depressive symptoms also grew stronger over time, but

only among females. A different dynamic for binge drinking is observed – for women, binge drinking is positively associated with their husbands' contact with friends. In general, these associations between spousal social participation and mental health are comparable in magnitude to those between one's own social participation and mental health, highlighting the importance of examining these dyadic dynamics.

Chapter 4 also explored gender differences in partner effects, which were found in two places. First, women's binge drinking is associated with their husbands' contact with friends, but their contact with their own friends does not affect their husband's binge drinking in the same way. Second, within-dyad imbalances in contact with friends are more strongly associated with wives' (vs. husbands') mental health. While the reasons for these associations remain unclear, findings suggest that women are generally more sensitive to some of their husbands' behaviors (or that of his friends) compared to vice versa. These findings contribute to the literature by providing context to the 'sex role hypothesis' (Gove 1972), which states that men are more likely than women to gain from the marriage relationship. By focusing in on the specific mechanism of social participation, the study shows that women's mental health may benefit less from the overall marriage relationship if couple dynamics in certain areas (i.e., imbalances in informal social participation) tend to be more detrimental for wives' (vs. husbands') mental health.

Chapter 4 further speaks to the literature around 'kin-keeping' (Rosenthal 1985) - while both husbands and wives benefit from contact with family (both own and spousal contact), within-dyad discrepancies in contact with family is associated with more depressive symptoms among women at later time points. This stresses the importance of the "linked lives" principle – relative levels of contact with family within the couple matters over and above absolute levels of contact with family; they may even be associated with mental health in opposite ways.

There are a number of common limitations across the chapters, which may possibly be addressed in future research. The first of these relate to causal interpretation. Because health can limit or promote social participation, there is a real risk of reverse causation. In this dissertation I have relied primarily on the findings of past studies to imply a causal direction, rather than employ a rigorous identification strategy. Results are therefore best interpreted as associations, rather than as causal estimates. This limitation is partly a practical one – for instance, it is not yet clear how best to construct a counterfactual for partner effects in dyadic growth curve models. Future research, possibly using novel statistical techniques, should thus seek to provide a more comprehensive account how of ways in which social participation and health affect each other over time (i.e., a dynamic, reciprocal relationship). Measurement is another limitation of these studies, since measures here assess traditional social activities such as attendance at meetings or visits with friends/family. Older adults may engage in many other forms of social interactions. For instance, seemingly mundane interactions with members of the community (e.g., barbers, shop owners) are not well captured, even though they may be important facets of an individual's social life. To this end, researchers may consider using global positioning system (GPS) technology in mobile phones to assess individuals' life spaces (Taylor, Buchan, and van der Veer 2019) and how/where they spend their time in the community. Further, traditional measures of social participation neglect newer modes of social participation more common among younger adults, such as online communication and organizing. While such an omission may not severely threaten the validity of the results in this dissertation since data used are from earlier-born cohorts (who are less likely to rely on the Internet as their primary mode of social participation), it does limit the generalizability of the findings to later-born cohorts. Scholars should seek to examine and account for the ways in which the Internet has changed what social participation

looks like, and how it may modify the association between social participation and health. To gain a better view of these online social activities, researchers may consider the use of digital trace data where available (Lazer and Radford 2017).

In sum, this dissertation applied the life course perspective to extend current understandings of social participation and health. It addressed long-standing gaps in the literature such as the overwhelming focus on social participation and health at older ages, the inability to separate age and cohort effects, and the assumption that social participation operates solely at the individual level. Across the chapters in the dissertation, findings can be broadly summarized into three key points (one from each paper). First, changes in social participation by age and cohort are less drastic than commonly assumed; older adults seem to compensate for lower informal social participation by increasing their formal social participation. Second, associations between social participation and health seem quite consistent across the life course, with one notable exception. That is, formal social participation becomes more important for males as they age – the association between formal social participation and depressive symptoms becomes stronger in old age. Third, when considering the association between social participation and mental health, spousal social participation is just as important to consider as one's own social participation. Overall, these findings contribute to the literature by demonstrating the new insights that can be gleaned by applying life course principles to the study of social participation and health. It provides impetus for scholars to further apply these principles in future research – e.g., exploring how the composition of social activities change over the life course, or how social participation functions in other types of "linked lives" such as parent-child dyads.

For those looking to use social participation as an intervention strategy (Raymond et al. 2013), this study has several implications. Practitioners or policymakers should view social

participation not only as something to deal with in late life, but across the entire life course. Given that the association between social participation and health seems largely consistent over the life course (Chapter 3), efforts aimed at improving population health through the promotion of social participation may find it more effective to start targeting individuals at younger ages. Doing so can promote health both in the short-term (since social participation is linked to health at younger ages too) and long-term (since social participation in early life is predictive of social participation in later life), possibly producing compounded returns on health. Paying attention to the way different types of social participation (e.g., formal or informal) are distributed at each age (Chapter 2) may also inform strategies to promote social participation in older adults (e.g., will befriender services promote health better than creating a formal club for activities, given that informal social participation tends to decline in old age?). Finally, interventions should consider targeting "linked lives" (e.g., parent-child, spousal dyads), rather than individuals in isolation. Results from Chapter 4 show that the social participation of just one member in a spousal dyad can influence the health of both members in the dyad. This suggests that working to improve social participation in both members at once may yield even greater health benefits, compared to only targeting one member. This finding also highlights the 'hidden' efficacy of social participation interventions to improve health outcomes for individuals – those who share a relationship with the target of intervention may also benefit as a result.

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