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All in the family? Understanding differences in the kin-centricity of older US adults' core discussion networks from classic age, period, and cohort table estimates

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ABSTRACT

Panel data have generated several insights about changes in kin relationships, yet few studies examine these shifts across multiple dimensions of time simultaneously. In this paper, we use data from the National Social Life, Health, and Aging Project (N = 5269) in classic lexis tables to examine age, period, and cohort differences in the kin-centricity of older adults' core discussion networks. We estimate population averages in discussion network size, range, kin composition, and kin co-residency across ages and periods. Results indicate that older adults' core discussion networks have become larger, more diverse, and less kin-centric over time. Comparisons of fit statistics across nested models indicate that period and age effects explain most of these changes. Our findings add nuance to concerns about a growing crisis of social isolation, suggesting that declines in core discussion network kin-centricity may be accompanied by the maintenance or addition of more alternative, non-kin close ties in later life.

1. Introduction

Changes in family relationships are a widely-studied barometer of how social, cultural, and environmental factors shape a wide range of individual-level outcomes and well-being (Seltzer 2019; Umberson and Thomeer 2020). Both public and academic narratives of an "epidemic of loneliness" and the increase in kinlessness among older adults have prompted a nuanced understanding of how family structures and relationships shift over time (Hawkley et al., 2019; Margolis and Verdery 2017; OSG, 2023; Silverstein and Giarrusso, 2010). Among older adults in particular, kinship ties are significant sources of social support with implications for health and well-being later in life (e.g., Wellman and Wortley 1990). As aging is often accompanied by declines in health and mobility, close kin relationships such as spouses or partners and adult children often provide informal care, and play a key role in reducing long-term care admission and in-home health care (e.g., Thomeer et al., 2015). Indeed, older adults who lack kin are considered to be at heightened risk for loneliness and associated health risks (Margolis and Verdery 2017). Age, period, and cohort differences are often used to contextualize these changes, documenting shifts in family structure as a result of life course processes, birth cohort, and historical exposures (Seltzer 2019).

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This work has generated important insights on the changing characteristics of specific kin dyads (e.g., spouses/partners), including their overall importance or closeness to individuals as they age. Yet few studies have asked: "Who are the most important social ties in older adults' lives, and how has the inclusion of kin within this set of important ties shifted over time?" In this study, we use core discussion networks as a lens for examining age, period, and cohort patterns in older adults' close kin relationships. Our consideration of temporal changes in kin relationships relies on individuals' subjective assessments of who they consider to be core social confidants, rather than beginning with predefined or a priori assumptions about particular kin ties and examining changes in the presence, closeness, or significance of them over time. We consider personal networks to be an advantageous framework for our purposes, as it represents an individual's "personal community of alters" (Small et al., 2021, p. 5), including individuals with whom they have personal contact (Vacca, 2020). A frequently-used survey-based approach to collect data about individuals' personal networks is through the administration of "name generators," which prompt respondents to enumerate those individuals with whom they have personal relationships. Name generators can prompt the enumeration of different types of personal network relationships, such as those with whom they socialize, confide in, seek assistance from, provide care, or even find difficult (e.g., Offer and Fischer, 2022).

One of the most commonly-used name generators is the "important matters" name generator, which elicits the set of social relationships with whom individuals discuss matters of personal importance, and who therefore represent their core discussion network, or confidant network, which usually consists of their close, most initimate social ties (Marsden 1987; Perry, Pescosolido, and Borgatti 2018a; Wasserman and Faust 1994). Among its use in several social surveys, the "important matters" name generator has been adminstered as part of the U.S. General Social Survey, providing the first nationally representative snapshot of core discussion networks and allowing for longitudinal studies of social connectedness and isolation in America (Marsden et al., 2020; Paik and Sanchagrin, 2013). Its use in the Survey of Health, Ageing and Retirement in Europe (SHARE) survey has allowed for the examination of family-based social capital as a predictor of higher levels of well-being (e.g., Litwin and Stoeckel, 2014) and the dynamic, reciprical (positive) associations between social network connectedness and mental health (Schwartz and Litwin, 2019), among other associations between core discussion network characteristics and older adults' health outcomes. For the purposes of our study, the core discussion network is especially useful because the "important matters" name generator does not impose any restrictions on the inclusion or exclusion of kin, allowing us to examine structural and compositional changes in respondents' core set of social confidants.

The core discussion network approach extends current understandings of changes in family processes in three key ways. First, the use of discussion networks allows for consideration of the relative importance of kin in an individual's core social life, and how that changes with age, by cohort, and historical period. Alongside the decline of the family and processes of individualization (Allan et al., 2001; Popenoe, 1993; Smock and Schwartz 2020), attitudes toward filial obligations have changed in recent decades (Fingerman et al., 2012). In this case, the mere presence of a kin tie, such as having a living sibling or adult child, does not necessarily inform the actual salience of that relationship in an individual's life. Indeed, one recent report indicates that the majority of adult children are not included in older European parents' core discussion networks (Schafer and Sun, 2021). Importantly, our approach does not dismiss the existence or potential relevance of ties (kin or non-kin) not included in the discussion network. Indeed, the composition of core discussion networks can change in response to changes in individual support needs and life course transitions (e.g., Alwin et al., 2018; Cornwell et al., 2021), and kin relations may be added or shed from a core discussion network accordingly. Rather, the discussion network approach focuses on eliciting information about a small set of core confidants with whom older adults tend to regularly interact during a particular time period.

Second, studies that examine changes in kin dyads often do not consider simultaneous shifts in non-kin ties. However, increasing kinlessness has increased the salience of friendships among older adults' core set of confidants (Mair 2019), making the core discussion network an ideal framework for examining shifts in important kin *and* non-kin ties. Third, our approach highlights a tension between the age-related increase in kin-centricity that is already demonstrated in the social network literature (Antonucci and Akiyama, 1987; Wellman and Wortley, 1989), and what would otherwise be predicted by cohort and period differences in family structure (e.g., Popenoe, 1993), yet which remain underexplored in the networks literature.

We leverage two rounds of data (2005/06 and 2015/16) from the National, Social Life, Health, and Aging Project (NSHAP) to examine the kin-centricity of older US adults' core discussion networks across ages and periods. While not true "age-period-cohort" (APC) models, we employ these data to estimate conditional cell means of a classic APC lexis table. Our focus on older adults is based on a heightened reliance on confidant networks that accompanies life course transitions in the later period of the life course (Abramson 2015; Carr 2019; Seeman 2000; Umberson et al. 2010). The NSHAP is, to our knowledge, the only dataset that collects core discussion network information from a probability-designed based nationally-represenatative sample of older adults in the United States (US) born between 1920 and 1965, with different measurement periods across ten years. In acknowledging challenges inherent to APC analyses, we combine a classic method with design-based estimates to produce a novel descriptive approach to estimate moderated age-period differences in core discussion networks, relying on post hoc tests of predicted means from fully adjusted regression models. We generate between-person estimates, comparing core discussion network information from older adults at a given age, period, and cohort, with the same core discussion network characteristics surveyed from older adults at other ages, periods, and cohorts. We discuss how these findings extend prior literature on time-varying characteristics of kin as a central part of older adults' social lives, with implications for patterns in both non-kin ties and social isolation.

1.1. Theoretical framework

1.1.1. Kin and older adults' core discussion networks

Core discussion networks include those core confidants who are typically close, frequently accessed social ties, with whom individuals discuss matters of personal importance and serve as a primary context of social integration (Marsden 1987; Bailey and

Marsden 1999; Mollenhorst et al., 2008). Broadly speaking, whereas personal networks include the direct ties of individuals (egos), global, sociocentric networks aim to capture the social ties of interest – both direct and indirect - among the individuals in a given population that is typically defined by a specific boundary (e.g., school, community, club or organizational membership) (Marsden, 2002; Smith and Christakis, 2008). Core discussion networks typically include the set of social ties that are most salient in individuals' navigation of personally significant events and everyday interactions. They are especially significant for health and well-being, representing primary sources of practical and emotional support, stress-buffering, and trusted sources of advice and social influence (Cornwell and Schafer 2016; Perry, Pescosolido, and Borgatti 2018b; Ellwardt et al., 2015b). This is particularly true for older adults, given the heightened health vulnerabilities that can accompany aging (Umberson et al. 2010; Wrzus et al., 2013; Guiaux et al. 2007), as well as transitions such as retirement and widowhood that can prompt shifts in the availability of core confidants and individuals' social support needs (Alwin et al. 2018).

The inclusion of kin is of primary interest in the study of confidant networks. Indeed, older adults' networks tend to be kin-centric: kin characterize between 65 and 70 percent of U.S. older adults' network members (Cornwell et al., 2009) and are among older adults' closest social network relationships (Antonucci et al., 2014; Raissi and Ackland, 2021). More so than non-kin network members, kin ties historically serve a range of social functions, and are generally long-standing, familiar social ties (Wellman and Wortley 1990). Additionally, the kin context carries norms of obligation and reciprocity, which support the particularly enduring nature of kin network ties (Offer and Fischer 2018b). Nevertheless, general measures of network kin do not necessarily capture more nuanced temporal shifts in what types of kin ties are among older adults' core confidants. Declines in family size, for example, may lead to fewer sibling or child core confidants, while greater life expectancy may increase the opportunity for an older adult to include a parent as a core discussion network member. An additional limitation is potential shifts in older adults' inclusion of "fictive kin", or those ties who are not related by blood or marriage yet are still counted as within their inner core of confidents, serving kin-like roles (Ebaugh and Curry, 2000; Mair 2019; Torres, 2019), as well as in how they negotiate and construct kinship networks amidst increasingly diverse family structures (Allan et al., 2001).

Whereas kin network ties confer benefits, an extensive or exclusive presence of kin may be restrictive. Kin network members are likely to have ties with one another by virtue of belonging to a shared family context (Feld 1981; Mollenhorst et al. 2014). Higher levels of connectedness that are characteristic of kin-centric core discussion networks can limit an individual's access to novel information and advice (Coleman 1988). Likewise, normative obligations to maintain kin ties may make it more difficult to distance oneself from straining kin ties (Offer and Fischer 2018b; Offer 2021). An advantageous core discussion network may therefore include a balance of both kin and non-kin ties (Burt, 2005; Marsden, 2018).

1.1.2. Existing frameworks for understanding change in kin ties

An extensive interdisciplinary literature interrogates how the presence and/or characteristics of kin ties change over time, and the implications of these patterns for individual and familial outcomes (Seltzer 2019; Smock and Schwartz 2020). Despite the emphasis on kin within social networks, the majority of the family structure literature focuses on changes for specific relationships, or kin dyads. Indeed, growing research documents changes with respect to the availability, interaction patterns, geographic proximity, and other characteristics of particular kin relationships such as spouses and sibling relationships (Seltzer 2019; Carr and Utz 2020). Studies often use age, period, and cohort to characterize these patterns. With respect to age, for example, marriage peaks at certain points across the life course, shaping the availability of spousal support. Likewise, cohort differences in fertility, living arrangements, and geographic proximity shape the structure and organization of older adults' family ties (Smock and Schwartz 2020; Carr and Utz 2020), while exposure to historical events, such as economic declines and technological advancements can have widespread implications for family processes (Ang, 2022; Cherlin et al., 2013).

Like family relationships, core discussion network structure and function change with shifting social and cultural environments (Huxhold 2019; Suanet and Huxhold, 2020; Fischer 2009; Alwin et al. 2018). Yet age, period, and cohort effects are seldom examined simultaneously to consider changes in the kin-centricity of these discussion networks (Suanet et al. 2013; Suanet and Huxhold, 2020). Here, we aim to examine and describe how the kin-centricity of older US adults' core discussion networks changes by age, period, and cohort. Below we discuss potential mechanisms for how and why discussion network kin-centricity might change along each of these dimensions to motivate our analysis. Although a formal test of these mechanisms is beyond the scope of the current study, we identify areas of future research in the Discussion.

Age. Arguably the most widely used frameworks for examining temporal changes in social networks focus on the significance of age. Empirical research generally finds that as older adults age, confidant networks decline in size and include fewer members beyond spouse/partner and child relationships (Cornwell et al., 2008; Shaw et al., 2007). Theoretical frameworks provide different perspectives on these changes. Socio-emotional selectivity theory posits that older adults selectively reduce their social network relationships with age. As individuals grow older, increasing awareness of the end of the life span prompts a shift away from expansive, peripheral social network ties (i.e., less interaction with non-kin) and increasingly toward those emotionally-satisfying and meaningful (i.e., more with close kin) (Albert et al., 2021; Carstensen, 1992; Fung et al., 2001). The convoy model likewise proposes that people "are surrounded by supportive others who move with them throughout the life course" (Antonucci et al., 2014, p. 84), with greater inclusion of kin as the closest social ties as individuals age (Antonucci et al., 2014).

Yet, contrary to portraits of disengagement or narrowing social lives, theories of compensation propose that the loss or decline of certain social relationships catalyzes the development of new or strengthening of existing social ties as an adaptive response (Cornwell and Laumann, 2018; Cornwell et al., 2020). The death of a spouse, for example, can prompt an increase in social support from kin, such as children and siblings (Guiaux et al., 2007) and non-kin (Iveniuk et al., 2020). Central to these perspectives is the more general application of life course theory, acknowledging that age-related transitions prompt change or reorganization of social connections in

ways that carry implications for the structure and function of kin in social networks (Wrzus et al., 2013; Alwin et al. 2018). Retirement, for example, may diminish more peripheral, work-based (non-kin) social network ties (Kauppi et al., 2021). Age-related mobility impairments and disability progression can lead to increased contact with adult child network members (Schafer and Upenieks 2021), while also inhibiting older adults' abilities to actively maintain network ties outside of the household or family contexts (Cornwell 2009; Umberson et al. 2010). In sum, social network and gerontology research propose that age is a key social force that undergirds changes in kin-centricity, with competing perspectives around the nuances of these changes within a longitudinal perspective. We first ask: how has the kin-centricity of older US adults' core discussion networks changed with age (*Research Question 1: age effect*)?

Period. Whereas age-related paradigms frame much of the research on social network change, broader period and cohort-level differences in kin relationships likely impact the kin-centricity of core discussion networks in ways that are largely underexplored within social network research. However, existing family research identifies potential mechanisms—including periods of economic uncertainty and technological adoption—related to specific characteristics of historical periods that may influence older adults' core discussion networks. We discuss these mechanisms as potential sources of any observed network change between periods and revisit this and alternative period mechanisms in our interpretation of the results in section 4.

First, periods of economic strain or uncertainty such as the Great Recession (2007–2009) represent recent historical exposures (i.e., period effects) that carry implications for family ties (Bengston, 2004). Indeed, two-thirds of adults in multigenerational households cited the economic downturn as a primary factor in their cohabitation. Older parents moving in with their adult children allowed for cost savings for both generations, and highlighted the erosion of financial security among older adults in retirement (Kadlec, 2012). Likewise, increasing shares of young adults began to reside with their parents after having previously moved out ("boomeranging") (Manning, 2020), with parents providing their adult children with more financial and emotional support than in previous decades (Connidis, 2014).

Additionally, the negative impacts of the Great Recession on employment, wealth, and spending for older adults and their family members are tied to higher risk of depressive symptoms, declines in cognitive functioning, and other poor health outcomes (Burgard et al. 2013; Burgard and Kalousova, 2015), which may lead to increases in network kin-centricity and kin co-residency as family assume caregiving roles for older adults in poor health. While we do not aim to estimate the direct or indirect effects of the Great Recession on core discussion networks, we consider the Great Recession to be a historical exposure that is connected to myriad personal difficulties that can have implications for changes in kin-centricity of older adults' core discussion networks before and after this recession.

Second, the widespread adoption of the Internet, smartphones, and other digital communication are among the most significant social and cultural influences on social life in the 21st century. Indeed, the proportion of adults aged 65 and older using the internet has grown from 22% in 2004 to 67% in 2016 (Anderson and Perrin 2017; Hunsaker and Hargittai 2018). Novel means of social interaction can facilitate the maintenance of non-kin ties as core discussion network members, who may have otherwise drifted apart or weakened due to geographic distance, or changes in routine social contexts (e.g., retirement) that might otherwise support ties with friends and neighbors (Feld 1981, 1997). Studies suggest that Internet use is positively associated the expansion of both core discussion and more expansive social networks (Chen, 2013), an increased likelihood in having non-kin core discussion network members (Hampton et al., 2011), and solidifying friendship ties through more continuous social interaction (Quan-Haase et al., 2021)—a new system of "networked individualism" that has enabled older adults to expand relationships to those outside the household and neighborhood (Ang, 2022; Rainie and Wellman, 2012). At the same time, remote social contact may not entirely replace in-person contact with regards to well-being, particularly with friends (Hawkley et al., 2021), but rather seem to enhance existing ties with both family and friends (Fingerman et al., 2020). In sum, although understudied, family research identifies potential sources of period-driven changes in older adults' core discussion networks. We next ask: how has the kin-centricity of older US adults' core discussion networks changed by historical period (*Research Question 2: period effect*)?

Cohort. Comparatively fewer studies have examined cohort-level differences in social networks (Fischer and Offer, 2019; Suanet et al. 2013). This is likely due in part to the relative dearth of available datasets that collect personal network data from multiple birth cohorts. Among Danish older adults, however, later-born cohorts have been documented to have less kin-centric personal networks compared to earlier-born cohorts and greater retention of friendship network ties (Suanet et al. 2013; Huxhold 2019).

Broader social and demographic trends experienced across cohorts—what researchers describe as the decline of the family—may help to explain these changes (Popenoe, 1993; Smock and Schwartz 2020). For example, generational differences in the tendency to move away from one's family of origin for educational or occupational pursuits can lower the inclusion of adult children in older parent's personal networks and household composition (Offer and Fischer 2018a). Greater geographic mobility may lead to sparser personal networks (Viry 2012), and prompt the inclusion of more non-kin as network members. Indeed, geographic distance between parents and adult children is inversely associated with a parent's inclusion of an adult child in their core discussion network, particularly for parents in poorer health (Sun and Schafer, 2022). And even adult children in close proximity may be less likely to be included in adults' networks as attitudes toward filial obligations have changed in recent decades, toward less involvement with aging parents and weakened family bonds in general (Fingerman et al., 2012; Schafer and Sun, 2021). In general, however, kinlessness (e.g., never marrying, experiencing a dissolution, or never having children) is also more common among later born cohorts compared to earlier (Margolis and Verdery 2017), as is living alone (Verdery et al., 2019). Alongside cultural shifts away from historical conceptualizations of family and friends (Allan et al., 2001; Pahl and Spencer, 2004; Popenoe, 1993), these trends may also lead to greater inclusion of non-kin—especially friends—in older adults' social networks (Mair 2019). Later born cohorts may also experience a temporary increase in network size following retirement, potentially reflecting cohort differences in the availability and use of time post-retirement, such as higher engagement in organized social activities (Suanet and Huxhold, 2020) that increase opportunities for developing non-kin ties. In sum, family demography research suggests that broader socio-economic trends throughout the 20th

century may correlate with larger, less kin-centric, and more diverse core discussion networks among later born versus earlier cohorts. Third, we ask: how has the kin-centricity of older US adults' core discussion networks changed across cohorts (*Research Question 3: cohort effect*)?

2. Data and methods

2.1. Sample

In this study, we ask: between 2005/06 and 2015/16, how has the kin-centricity of older US adults' core discussion networks changed with age (Research Question 1), by historical period (Research Question 2), and across cohorts (Research Question 3)? We explore these research questions empirically, then compare the relative effects of age, period, and cohort to enhance our understanding of these changes. We use data from the NSHAP, a population-based panel study of non-institutionalized older adults in the US designed to understand the intersection of health and the social context. Round 1 was collected in 2005/06 (Round 1) from a probability sample of 3005 U.S. community-dwelling adults born 1920–1947 ("Cohort 1") that consisted of one respondent per household and over-sampled Black and Hispanic populations, as well as older men (O'Muircheartaigh et al., 2009). Round 2 was collected in 2010/11 ($N = 3377$) among all surviving respondents, regardless of their Round 1 participation, and their co-resident spouses or partners, regardless of age (O'Muircheartaigh et al., 2014). Round 3 was collected in 2015/16 ($N = 4777$) among all surviving respondents from previous rounds (Cohort 1 and their partners), as well as a new sample of U.S. adults born in 1948–1965 ("Cohort 2"), including their co-resident spouses or partners, regardless of age. The conditional response rate for returning baseline/Cohort 1 respondents in Round 3 was 89.2%. Response rates were 75.5%, 74%, and 71% for each of the three round, respectively. In-home interviews were conducted by NORC using Computer Assisted Personal Interviewing (CAPI), followed by a leave-behind questionnaire (LBQ), which respondents were asked to complete and return by mail.

2.2. Measures

Network characteristics. The NSHAP collected core discussion network data from all respondents at all rounds as part of the in-home interview. At each round, respondents were prompted with the following "important matters" name generator: "From time to time, most people discuss things that are important to them with others. For example, these may include good or bad things that happen to you, problems you are having, or important concerns you may have. Looking back over the last 12 months, who are the people with whom you most often discussed things that were important to you?" Respondents could name up to five network members (i.e., "alters"), who collectively comprised Roster A.[1] Following enumeration of their network members, respondents were asked to identify their relationship type to each alter (e.g., spouse/partner, friend) and, for each alter, to report how frequently they interact and whether they co-reside.

The primary goal of this study is to examine how the kin-centricity of older US adults' core discussion networks change with age, across period, and by cohort. To do so, we consider four characteristics of respondents' core discussion networks that together capture both the general structural of the network, as well as the centrality of family within it, and that are likely to reflect the age, period, and cohort differences in social life that are documented in the prior research reviewed.

Network size is the total number of network members named in Roster A, ranging from "0" (no network members named) to "5" (the maximum number of network members that respondents were allowed to provide) (Cornwell et al., 2009). Respondents were prompted to categorize each network relationship selecting one type from 18 possible different categories, including multiple categories of kin and non-kin relationships.[2] We measure *network range* as a count of the different types of relationships with the network members named in Roster A. Although network members might serve multiple social roles in a respondent's network (e.g., a friend and a neighbor), the NSHAP allowed respondents to select only one relationship category for each network alter. Our *network range* measure is based on respondents' reports of the relationship type for each member named. Because respondents could only select one relationship type for each member, this measure ranges from "0" (no network members named) to "5" (5 network members named, each of whom represent distinct relationship categories). Network range is often used as a measure of network diversity, capturing the number of different relationships—both kin and non-kin—and the potentially diverse social roles, environments, and activities associated with each alter included in the network (Cohen et al., 1997; Ellwardt et al. 2015). As family forms become more complex and diverse over time, network range may capture this diversity in close kin relationships (Allan et al., 2001). We derive a measure of *percent network that is kin,* calculated as the percent of all alters reported in Roster A who are family members. This measure reflects the overall extent to which respondents' network members come from the family context and is our primary indicator of core discussion network kin-centricity. We categorize all alters identified as spouse, ex-spouse, romantic/sexual partner, parent, parent in-law, child,

[1] In all rounds of data collection, Roster B captures respondents' spouse or romantic partner, if not included in Roster A. In Rounds 1 and 2 only, respondents were then asked, "(Besides the people you had already listed), is there anyone (else) who is very important to you, perhaps someone with whom you feel especially close?" If a such a person exists, they are recorded in Roster C. Analyses focus only on Roster A because Roster B forces the inclusion of a kin tie in the core discussion network and because Roster C was not asked in Round 3.

[2] Spouse; ex-spouse; romantic/sexual partner; parent; parent in-law; child; step-child; brother or sister; other relative; other in-law; friend; neighbor; co-worker or boss minister, priest, or other clergy; psychiatrist, psychologist, counselor; caseworker/social worker; housekeeper/home health care provider; other.

step-child, brother or sister, other relative, or grandchild as kin. Results excluding "other relative" from analyses yield near identical results. We include this kin category given the fact that, regardless of whether defined as close or distant, these social ties are reported as close confidants and reflect the diversity in close kin ties across race and socio-economic status (Taylor et al., 2013), as well as geographic and social space (Murphy 2008). Importantly, many prior studies tend to define kin as relations by blood or marriage. This dichotomization can categorize as "non-kin" those social ties who respondents consider to be kin based on their closeness, norms of reciprocity, and/or social resources conferred within the relationship, but who are not related by blood or marriage (e.g., "fictive kin"; Ebaugh and Curry, 2000). In the context of the current study, it is possible that respondents categorize these types of social network ties as "other relative," which comprises 14% of all kin ties reported.

Alternatively, respondents could categorize such social relationships using categories such as "friend" (78% of all non-kin ties), "neighbor" (7%), or other "non-kin" categories (e.g., coworkers or bosses, 7%). As the "important matters" name generator intentionally prompts respondents to enumerate their *close social ties*, and by examining several network measures, we aim to shed light on age, period, and cohort differences in the extent to which older adults are including social ties within this inner core of social confidants serving kin-like roles, but who may not be categorized as such in more traditional definitions. Finally, *number co-residing kin network members* is derived as the number of network alters who are kin and who also live with the respondent (range 0–5).

Examining these four core discussion network dimensions simultaneously allows for a more nuanced understanding of how core discussion network kin-centricity changes over time than what can be gleaned from a single measure alone. Indeed, percent kin alone does not reflect changes in the overall number of network confidants, which may be growing or shrinking as a result of technology-driven growth in opportunities to maintain social contacts, while also maintaining a stable percentage of kin network members.

Demographic and Health Covariates. We include key covariates that have been documented to correlate with family structure and social network composition (e.g., Albert and Hajdu, 2020; Taylor et al., 2013). The NSHAP calculates *age* in years as the difference between respondent-reported date of birth and the date of the interview. Analyses included a dichotomous measure indicating whether the respondent was *married or living with their partner* (not married and/or living with partner as reference) at the time of the interview, and interviewer-coded *gender* (male as reference). *Race/ethnicity* was coded as non-Hispanic White (reference), non-Hispanic Black/African American, and Hispanic; those coded as "Other" (3.1%) were dropped from analyses due to data limitations for weighting, which we discuss in more detail in the following section. *Educational attainment* was self-reported and categorized as less than high school, high school equivalent (reference), some college, or Bachelor's or more.

We also accounted for *self-reported physical health*, which was rated on a scale of "Poor" (1) to "Excellent" (5). A comorbidity score was constructed by summing a set of conditions that respondents were told by a doctor that they had (possible range 0–16; respective points assigned in parentheses): congestive heart failure (1), heart attack (1), coronary procedure (1), stroke (1), diabetes (1), arthritis (1), chronic pulmonary disease (1), dementia (1), non-metastatic cancer excluding skin-cancer (2), and metastatic cancer other than skin cancer (6) (Vasilopoulos et al., 2014). Analyses also included a continuous measure of the total number of Activities of Daily Living (ADLs) (walking across the room, dressing, bathing, eating, getting in and out of bed, toileting) with which respondents reported having at least "some difficulty."

2.3. Analytic Strategy

Our goal is to understand age, period, and cohort differences in the kin-centricity of older US adults' core discussion networks. We focus on between-person rather than within-person changes over time in order to optimize the data and points of comparison along age, period, and cohort lines of inquiry. Our analytic sample included all responses from Rounds 1 and 3 of data collection among all sampled respondents between the ages of 57 and 85 years. Excluding responses from Round 2 (2010/11) provided the largest possible window of observation, and thus allowed for maximum variation in age (e.g., 10 years), period (e.g., 2005/06 to 2015/16), and cohort (e.g., distinct cohorts spanning 10 birth years). Moreover, excluding respondents outside this age range ($N = 1122$) ensured the age bins we examined in both rounds of data collection were comparable. We further focused on sampled respondents and excluded partners who were also interviewed ($N = 947$), since their participation was not based on their representativeness of the older US population generally. We used listwise deletion to handle missing data, which resulted in the exclusion of fifteen respondents.

In addition to these inclusion criteria, we applied survey weights to ensure the data were representative of the older US adult population in 2005/06 and in 2015/16. The NSHAP includes person-level weights that are designed to follow respondents who are representative of a given cohort (e.g., Cohort 1) over time. For example, they account for non-response for Cohort 1 respondents who are re-interviewed in Round 3, but are not necessarily representative of the general older US adult population at Round 3. Because our analysis relied on pooled observations from Rounds 1 and 3, we derived our own post-stratification survey weights to correct for sampling bias. We used data from the American Community Survey (ACS) for years 2005 and 2015 to calculate proportions of the US population belonging to various sub-populations (race/ethnicity, gender, age). We then divided the US population proportion by their respective proportion in our analytic sample (NSHAP), and weighted survey responses accordingly. Our final analytic sample included 5269 observations: 2911 from Round 1 respondents and 2358 from Round 3 respondents.

We use a novel, descriptive approach to examine between-person APC changes in the kin-centricity of older US adults' core discussion networks. Studies have long sought to tease apart these effects on a particular outcome of interest (Glenn, 2005), with various approaches for addressing the multicollinearity between age, period, and cohort (see Fosse and Winship, 2019). Here, we estimate separate linear regression models using Rounds 1 and 3 of the NSHAP for each of the four network characteristics of interest. In each model, we included an indicator for the time period (survey round) from which the measures were drawn (2005/06 or 2015/16), spanning the time period in which the Great Recession and widespread smartphone and Internet adoption occurred, and age "bins" that categorize respondents' age into 10-year groups (51–60, 61–70, 71–80, 81–90), as well as an interaction effect between period and

age bins. All models control for the full set of demographic and health covariates.

We then produce predicted means for each age bin and in each of the two time periods. We use post hoc analyses to compare conditional predicted means for each network characteristic along our APC lines of inquiry. Specifically, we first look at means for each age bin across the two time periods, assessing whether a particular network characteristic is statistically different for people of the same age, in two different time periods (*Research question 2: period effect)*, which allows us to examine how people of a particular age group experience particular time periods differently with regards to the kin-centricity of their core discussion networks. We then examine whether core discussion network characteristics changed as individuals grew older; that is: the difference for a particular 10-year age bin as they "aged" 10 years between rounds of data collection (*Research Question 1: age effect)*. Last, we consider whether these network characteristics varied between age bins within the same time period, or whether people of different ages (i.e., born in different 10-year birth cohorts) experienced different social networks with regards to family within the same period of history (*Research Question 3: cohort effect)*.

Our method can be understood as the production and analysis of a classic lexis table (Fischer and Winship, 2019, p. 470) from the survey data. Specifically, Table 1 and 2 summarizes our main table of results (Table 3) and is made of $k = \{1, 2, \ldots K\}$ age rows and $j = \{1, J = 2\}$ period columns. After we fit a linear model (described below), we produced $K \times J$ marginal predictions for each age group and period combination, holding covariates to sample means. This table is from an estimated vector $\boldsymbol{B}$ that is has $K \times J$ elements, each element corresponding to a cell in our lexis table. We also produce a symmetrical sampling variance-covariance matrix $\boldsymbol{V}$ that has $(K \times J)$ rows and $(K \times J)$ columns and each diagonal element is the sampling variance ($V\left\{\widehat{\mu}_{kj}\right\}$) of a cell in our lexis table and the off-diagonals are covariances ($CV\left\{\widehat{\mu}_{kj}; \widehat{\mu}_{k'j'}\right\}$). With these set of values, the cohort difference within period j for age category k is

$$\Delta_k = \widehat{\mu}_{kj} - \widehat{\mu}_{k-1\,j}$$

with a standard error of

$$SE\{\Delta_k\} = \sqrt{V\left\{\widehat{\mu}_{kj}\right\} + V\left\{\widehat{\mu}_{k-1\,j}\right\} - 2 \times CV\left\{\widehat{\mu}_{kj}; \widehat{\mu}_{k-1\,j}\right\}}$$

With a test-statistic of the ratio $\frac{\Delta_k}{SE\{\Delta_k\}}$ that is evaluated against a student's *t*-distribution with degrees of freedom associated with the survey regression estimation procedure. The period difference is similarly noted as

$$\Delta_j = \widehat{\mu}_{kj} - \widehat{\mu}_{kj-1}$$

with a similar standard error

$$SE\{\Delta_j\} = \sqrt{V\left\{\widehat{\mu}_{kj}\right\} + V\left\{\widehat{\mu}_{kj-1}\right\} - 2 \times CV\left\{\widehat{\mu}_{kj}; \widehat{\mu}_{kj-1}\right\}}$$

Finally, the age difference is noted as

$$\Delta_{kj} = \widehat{\mu}_{kj} - \widehat{\mu}_{k-1\,j-1}$$

with the standard error

$$SE\{\Delta_{kj}\} = \sqrt{V\left\{\widehat{\mu}_{kj}\right\} + V\left\{\widehat{\mu}_{k-1\,j-1}\right\} - 2 \times CV\left\{\widehat{\mu}_{kj}; \widehat{\mu}_{k-1\,j-1}\right\}}$$

We convert the differences (Δ) into correlations through meta-analysis conversions by first taking the Cohen's d effect size ($d = \frac{\Delta}{\sigma}$) and converting those values into a correlation $r = \frac{d}{\sqrt{d^2+4}}$ (Borenstein et al., 2021). We convert the effect sizes to correlation coefficients to ease interpretability of these differences across network characteristics, as well as to illustrate the magnitude of age, period, and cohort differences (for a table presenting the differences in means, see Table A1 in Appendix A).

Table 1
Lexis Table example.

	J Periods	
	$j = 1$	$j = 2$
K Age Categories		
$k = 1$	$\widehat{\mu}_{1,1}$	$\widehat{\mu}_{1,2}$
$k = 2$	$\widehat{\mu}_{2,1}$	$\widehat{\mu}_{2,2}$
…	…	…
$k = K$	$\widehat{\mu}_{K,1}$	$\widehat{\mu}_{K,2}$

Finally, for each network characteristic, we conduct a series of post-hoc Wald tests after each respective regression model to determine whether a particular measure or set of measures (e.g., period, age bins) improves model fit. In all models, we applied sampling weights derived from the ACS.

3. Results

3.1. Descriptive statistics

Table 2 presents descriptive statistics of older adults' core discussion network characteristics and key covariates used in our analysis, pooling data from Rounds 1 and 3. We estimate that older adults had an average discussion network size of 3.75 persons (SD = 1.41) and co-resided with between 0 and 1 kin network ties ($M = 0.56$, SD = 0.63). Older adults' networks included between 2 and 3 different types of social relationships (mean network range = 2.47; SD = 1.02) and tended to be comprised of majority kin (64% kin network members, SD = 0.33). Spouses/partners accounted for 15% of all older adults' networks members, children 29%, siblings 11%, and other relative 9%. Again, "other relative" may capture any alter who the respondent considers to be family but who does not fit into the other categories.

On average, respondents were 67.7 years old (SD = 7.6), the majority of whom were married (63%) and women (53%). Eighty percent of respondents identified as White, 12% as Black/African American, and 8% as Hispanic. Between one-quarter and one-third of respondents attained a high school diploma or equivalent (25%), some college (34%), or a Bachelor's degree or more (26%); 15% had attained less than a high school diploma. On average, respondents reported "good" self-rated health ($M = 3.28$; SD = 1.07), between 1 and 2 comorbidities ($M = 1.32$), and fewer than 1 ADLs ($M = 0.57$).

3.2. Multivariable results: age, period, and cohort differences

We next used multivariable linear regression models to describe patterns in the kin-centricity of older adults' core discussion networks by age, period, and cohort, controlling for respondent characteristics. Fig. 1 illustrates how we present our estimations of differences for specific age categories across period (1a; *Research Question 2*), as they age 10 years (1b; *Research Question 1*), and cohort (1c; *Research Question 3*) for each of the four network outcomes, using *network size* as an example. For clarity, each respective sub-figure in Fig. 1 presents only those estimated differences of interest; our main table of results presents differences for these age bins across period, by age, and across cohorts simultaneously to ease interpretation and comparison of results. Fig. 1a depicts a period effect, or the difference between conditional predicted means in *network size* for the average individual aged 61–70 in 2005/06 and 2015/16 (horizontal line); Fig. 1b depicts age effects (diagonal line), illustrating the difference in *network size* across 10-years for older adults who were ages 61–70 in 2005/06, and ages 71–80 in 2015/16. Fig. 1c depicts cohort effects (vertical line), comparing differences in *network size* among older adults of different ages (i.e., born in different 10-year birth cohorts) at a single time point. The right-most columns in Fig. 1 display the magnitudes of these differences for period, age, and cohort, respectively. We use Excel's conditioning formatting function so that larger values (i.e., larger correlation coefficients) appear darker in Table 3. For the differences in means and

Table 2
Estimated means (or proportions) of core discussion network characteristics and key covariates for the US community-dwelling population aged 57–85, 2005/06 and 2015/16 (N = 5269).

Variable	Mean/proportion	SD	Range
Core discussion network characteristics			
Network size	3.75	1.41	0–5
Number co-residing kin network members	0.56	0.63	0–5
Network range	2.47	1.02	0–5
Percent network is kin	0.64	0.33	0–1
Demographics			
Age in years	67.7	7.64	57–85
Married	0.63	0.48	0–1
Proportion women	0.53	0.5	0–1
Race/ethnicity (proportions)			
White	0.81	0.39	0–1
Black/African American	0.12	0.32	0–1
Hispanic	0.08	0.26	0–1
Education (proportions)			
< high school	0.15	0.36	0–1
High school or equivalent	0.25	0.44	0–1
Some college	0.34	0.47	0–1
Bachelor's or more	0.26	0.44	0–1
Health characteristics			
Self-rated health (1–5)	3.28	1.07	1–5
Comorbidities (0–11)	1.32	1.38	0–10
Activities for Daily Living (0–6)	0.57	1.25	0–6

Note: survey responses are weighted using post-stratification survey weights based on information from the American Community Survey (ACS) in years in which data were collected, 2005/06 (N = 2911) and 2015/16 (N = 2358).

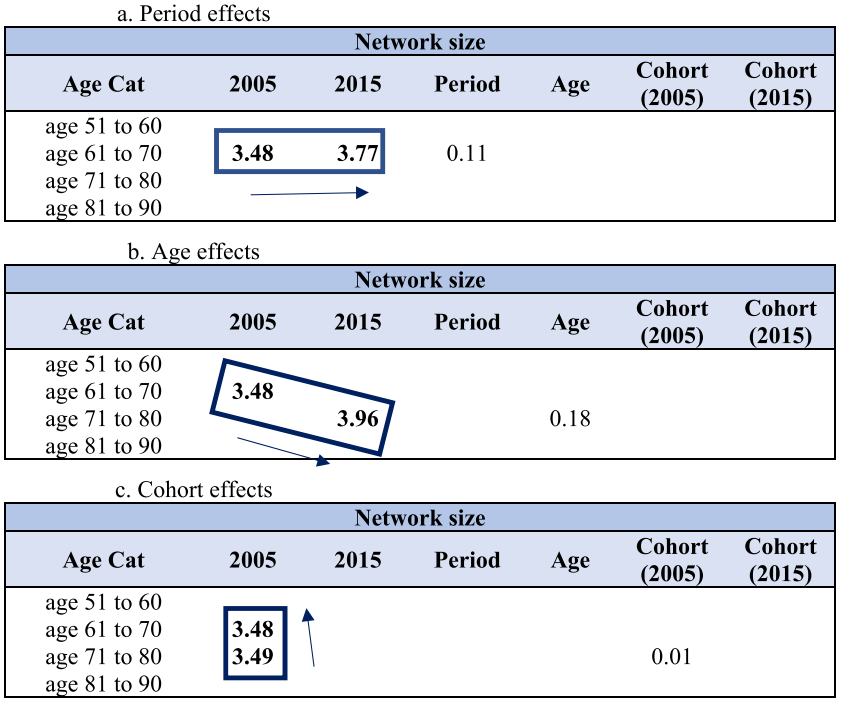

Fig. 1. Illustration of post hoc tests for statistical significance in difference between predicted means for age bin 61-70 in 2005/06 and 2015/16 for *network size* along period (a), age (b), and cohort (c) lines of inquiry, converted into Pearson correlation coefficients (*r*)
Fig. 1a. Period effects. Fig. 1b. Age effects. Fig. 1c. Cohort effects.

Table 3
Conditional predicted means of 10-year age bins in 2005/06 and 2015/16 from linear regression models predicting older adults' core discussion network characteristics with differences in means along age, period, and cohort lines, converted into Pearson Correlation Coefficients (*r*).

Network size							# Co-residing kin network members						
Age Cat	2005	2015	Period	Age	Cohort (2005)	Cohort (2015)	Age Cat	2005	2015	Period	Age	Cohort (2005)	Cohort (2015)
age 51 to 60	**3.61**	**3.95**	0.13				age 51 to 60	**0.70**	**0.71**	0.01			
age 61 to 70	**3.48**	**3.77**	0.11	0.06	-0.05	-0.07	age 61 to 70	**0.62**	**0.65**	0.03	-0.04	-0.06	-0.05
age 71 to 80	**3.49**	**3.96**	0.18	0.18	0.01	0.07	age 71 to 80	**0.54**	**0.58**	0.03	-0.03	-0.06	-0.05
age 81 to 90	**3.51**	**3.85**	0.13	0.14	0.01	-0.04	age 81 to 90	**0.55**	**0.50**	-0.04	-0.03	0.01	-0.06

Network range							% Network is kin						
Age Cat	2005	2015	Period	Age	Cohort (2005)	Cohort (2015)	Age Cat	2005	2015	Period	Age	Cohort (2005)	Cohort (2015)
age 51 to 60	**2.57**	**2.79**	0.10				age 51 to 60	**0.67**	**0.60**	-0.11			
age 61 to 70	**2.32**	**2.59**	0.12	0.01	-0.12	-0.10	age 61 to 70	**0.67**	**0.64**	-0.05	-0.05	0.00	0.05
age 71 to 80	**2.26**	**2.57**	0.30	0.12	-0.03	-0.01	age 71 to 80	**0.68**	**0.64**	-0.06	-0.05	0.01	0.01
age 81 to 90	**2.30**	**2.42**	0.15	0.07	0.02	-0.07	age 81 to 90	**0.70**	**0.65**	-0.07	-0.04	0.03	0.02

Notes: Results are from four separate fully adjusted linear regression models that apply post-stratification survey weights using the ACS data from 2005 to 2015. Bolded values indicate average marginal effects for specific age bins in a particular period for a respective network characteristic. Shaded values indicate differences in these means, converted to correlation coefficients (*r*), by year (i.e., along horizontal lines), age (i.e., along diagonal), and cohort (i.e., along vertical, for both 2005/06 and 2015/16). Darker shading indicates larger correlations; red shades indicate negative correlations and blue shades, positive.

corresponding tests of statistical significance, rather than the Pearson Correlation Coefficients, see Table A1 in Appendix A.

Period effect (Research Question 2). We first examine the core discussion network characteristics of older adults of similar ages across distinct periods (2005/06 vs. 2015/16). Table 3 presents predicted means, converted into correlation coefficients, for each 10-year age bin and for each of the four network characteristics, accounting for the full set of covariates and applying post-stratification weights. To ease interpretation of the relative strength of these correlations, we use red shades to indicate negative correlations and blue shades for positive, with darker shading indicating larger correlations. Period effects are calculated as the difference between conditional predicted means for a given age bin in 2005/06 and in 2015/16. For example, 0.13 represents the correlation coefficient in the difference in means between the typical US adult aged 51–60 in 2005/06 (3.61) and the typical US adult aged 51–60 in 2015/16 (3.95). Two features of this statistic and others in Table 3 are noteworthy. One, the correlation coefficient in this example ($r = 0.13$) is generally

weak in strength (Brydges, 2019), although represents a statistically significant difference in means among adults in this age bin between these two time periods (0.35; $p < .001$, Table A1). Two, this difference in means is relatively smaller than other differences in means when converted into effect sizes, as is evidenced in the relative strength in reds and blues in Table 3. We take these considerations into account while interpreting our results here and in the discussion. In general, we discuss meaningful patterns presented in Table 3, most of which align with statistically significant differences presented in Table A1.

Post hoc comparisons in these conditional predicted means suggest that respondents in all four age bins reported larger *network sizes* (r ranging between 0.11 and 0.18) in 2015/16 than did respondents in the same age bin in 2005/16. The *number of co-residing kin network members* across the same time period also increased for three of four age bins, although none of these differences are substantially meaningful or statistically significant (Table A1).

Results from similar models to those presented in the top-most rows of Table 3 are presented below these for *network range* (left-most columns) and *% network that is kin* (right-most columns). Conditional predicted means for most 10-year age bins increased significantly between 2005/06 and 2015/16 for *network range* (r ranging between 0.10 and 0.30). Although all bins experienced a decrease in *% network that is kin*, only the 51–60 age bin reported a relatively larger decrease between 2005/06 and 2015/16 ($r = -0.11$).

Looking across the 10-year period effects for all core discussion network characteristics, we can draw inferences about the average

Table 4
Linear regression models reporting coefficients and standard errors of the relationships between age bins (age), year (period), and an interaction between them (cohort) and older US adults' social network characteristics, 2005/06 and 2015/16.

	Network size		# Co-residing kin network members		Network range		% Network is kin	
	Model 1		Model 2		Model 3		Model 4	
Age (age bins; ref: 51 to 60)								
61 to 70	−0.13		−0.09	**	−0.25	***	0.00	
	0.08		0.03		0.06		0.02	
71 to 80	−0.11		−0.16	***	−0.31	***	0.00	
	0.08		0.03		0.06		0.02	
81 to 90	−0.10		−0.15	***	−0.27	***	0.02	
	0.11		0.04		0.08		0.03	
Period: 2015 (ref: 2005/06)	0.35	***	0.01		0.22	**	−0.07	**
	0.10		0.04		0.07		0.02	
Cohort/age bins X period								
61 to 70 X 2015/16	−0.06		0.02		0.04		0.04	
	0.12		0.05		0.09		0.03	
71 to 80 X 2015/16	0.12		0.03		0.10		0.03	
	0.12		0.05		0.09		0.03	
81 to 90 X 2015/16	0.00		−0.06		−0.10		0.03	
	0.15		0.06		0.11		0.04	
Other key factors								
Female	0.48	***	−0.07	***	0.25	***	−0.02	
	0.05		0.02		0.03		0.01	
Married	0.25	***	0.66	***	0.44	***	0.11	***
	0.05		0.02		0.04		0.01	
Race/ethnicity (ref: White)								
Black	−0.29	***	−0.01		−0.13	**	0.03	
	0.07		0.03		0.05		0.02	
Non-Black Hispanic	−0.22	**	0.05		−0.28	***	0.07	***
	0.08		0.04		0.06		0.02	
Educational attainment (ref: high school or equivalent)								
< high school	−0.28	***	−0.05		−0.24	***	−0.02	
	0.08		0.03		0.05		0.02	
Some college	0.24	***	0.00		0.10	*	−0.07	***
	0.06		0.02		0.04		0.01	
Bachelor's or more	0.49	***	0.03		0.21	***	−0.11	***
	0.06		0.02		0.05		0.02	
Health-related								
Physical health	0.07	*	−0.02	*	0.01		−0.01	
	0.03		0.01		0.02		0.01	
Comorbidities	0.05	**	0.01		0.03	*	0.00	
	0.02		0.01		0.01		0.00	
Activities for Daily Living (ADL)	0.00		0.01		−0.01		0.00	
	0.02		0.01		0.01		0.00	
Intercept	2.78	***	0.38	***	2.07	***	0.68	***
	0.13		0.05		0.09		0.03	
p-value	0.00		0.00		0.00		0.00	
N	5269		5269		5169		5169	

Note: Standard errors are presented below estimates. Measures of social network characteristics are coded so that higher values represent greater network size, living with more family, greater network range, greater % network that is kin. *$p < .05$; **$p < .01$; $p < .001$.

experience of a US adult. For example, a 65-year-old who may be on the cusp of retirement in 2005/06 had a network size of 3.48, lived with between 0 and 1 close family members (0.62), and had 2.32 different social relationship types in their network (*network range*). Sixty-seven percent of their network confidants were family members. An individual aged 65 in 2015/16, however, would have a significantly larger network size (3.77; $p < .001$) and range (2.59; $p < .001$). They would be living with roughly the same number of close family members (0.65; n.s.) and have a slightly less kin-centric discussion network (64%; $p < .05$). Tests of statistical significance between means are presented in Table A1.

Age effect (Research Question 1). We next examine patterns in conditional predicted means and corresponding post hoc comparisons between age bins in the two time periods, 10 years apart (i.e., 2005/06 and 2015/16), along age lines. In Table 3, we present estimated differences by age in the columns to the immediate right of those discussed for period. Here, we ask: how has the kin-centricity of core discussion networks changed as older adults grow older (*age*)? Results suggest that there is an aging effect for *network size*: individuals' networks grew larger as they aged, although this is primarily driven by older adults who are aging into their 70s and 80s ($r = 0.18$ and 14, respectively). The *number of co-residing kin network members* decreased with age for all age bins, although these changes are negligible. Similarly, older adults report larger *network ranges* as they age, and this was again particularly true for individuals in their 70s and 80s ($r = 0.12$ and 0.07, respectively). All age bins reported networks comprised of fewer family members as they aged, with significant differences among those aging into their 70s and 80s ($r = -0.05$ for both age bins), although these differences are substantially small.

To summarize these descriptive patterns, we can again think about the average experience for the same US adult aged 65 in 2005/06. This time, we can watch this individual age into their 70s by 2015/16: their network has grown significantly ($p < .001$) by 0.48 persons, yet they live with more or less the same number of network members who are family (n.s.). Their network range has also increased, including more distinct types of social relationships (0.25; $p < .001$), and has decreased significantly in its kin composition (-0.03; $p < .05$). We note that, although this latter effect is statistically significant here and by period, they are not substantially large (Table A1). We interpret this and other similar results in the Discussion.

Cohort effect (Research Question 3). We next present correlation coefficients (r) for estimated differences for cohorts in each time period (2005/06 and 2015/16, respectively) in the right-most columns in Table 3. We ask: within the same history (time period), how have older adults from different birth cohorts differed with regards to their core discussion network characteristics? In contrast to period and age, we find some evidence of cohort effects, although to a much lesser extent. Adults in their 60s reported a significantly smaller *network size* in 2015/16 compared to those both in their 50s and in their 70s ($r = -0.07$ and 0.07, respectively); no significant cohort differences emerged in 2005/06. Older cohorts also reported *co-residing with fewer kin network members* in 2015/16, with a significant difference for those in their 70s, relative to adults in their 60s ($r = -0.05$), as well as for those in their 80s, relative to those in their 70s ($r = -0.06$). The same pattern emerges in 2005/06, although among younger cohorts: those in their 60s report fewer co-residing kin network members than those in their 50s, as do those in their 70s relative to those in their 60s (both r = -0.06). Again, although these effects are statistically significant, they are substantially small (Table A1). Older cohorts also reported smaller *network ranges*, particularly those in their 60s relative to those in their 50s, and this is true in both 2005/06 and 2015/16 (r = -0.12 and -0.10, respectively). Those in their 90s also reported a smaller network range than those in their 80s in 2015 (r -0.07). We observe no cohort differences in *percent network that is kin.*

We again think about an average 65-year-old US adult: they live with significantly fewer network family members than does the average 55-year old, for example, although only in 2005/06 (-0.09; $p < .01$). They also have a significantly smaller core discussion network size (-0.18; $p < .05$), although only in 2015/16, and less diverse networks, in both 2005/06 (-0.25; $p < .001$) and 2015/16 (-0.20; $p < .01$), than their younger peers.

Relative strength of age, period, and/or cohort effects. Finally, we revisit our population weighted linear regression models to examine which factor(s)—age, period, and/or cohort—may be most powerful in explaining the differences in core discussion network characteristics observed in Table 3. We present results from the four separate linear regression models in Table 4, with those predicting *network size* in the left-most column (Model 1), and *number of co-residing kin network members* (Model 2), *network range* (Model 3), and *% network that is kin* (Model 4) to the right. Again, all models control for other key factors and use post-stratification weights based on ACS data. Note that these are the models used to produce predicted means and corresponding correlation coefficients (Tables A1 and 3, respectively), with results in Table 4 providing higher-level insights into APC patterns, rather than differences across specific age bins.

For each model, we run a series of post-hoc Wald tests to assess whether a particular measure or set of measures—age bins, period dummy, or interaction between them—improves model fit, respectively. We find that age significantly improves model fit for *number co-residing kin network members* (F (3, 3869); $p < .001$), whereas period improves model fit for both *network size* (F (3, 3941); $p < 001$) and *% network that is kin* (F (1, 3871); $p < .01$). Both period and age improve model fit for *network range* (F (1, 3871); $p < .01$ and F (3, 3869) $p < .001$, respectively). Results from the Wald tests are consistent with those presented in the Models: period effects are significant for *network size* (Model 1; $p < .001$), *network range* (Model 3; $p < .01$), and *% network that is kin* (Model 4; $p < .01$), whereas age effects are significant for both *number co-residing kin network members* (Model 2; age bin 61-70 $p < .01$, all else $p < .001$) and *network range* (Model 3; all age bins $p < .001$). We also estimated a series of nested models and the associated changes in R^2 to assess additional variance explained in a given network characteristic when a particular APC measure is added to a baseline model. Results are nearly identical to the findings from the Wald tests, although suggest that age significantly improves model fit for *network size*, in addition to period.

A deeper look. Results presented in Tables 3 and 4 do indeed suggest noteworthy patterns: that older adults' core discussion networks increase in size and diversity, alongside, to a lesser extent, declines in co-residential kin network members and percent network that is kin. Although beyond the primary aims of the present study, we estimate two additional models to assess whether patterns in the *number of kin* and the *number of non-kin* network members that older adults report align with these findings using the same approach to

that described in Section 2.3. Results are consistent with those shown in Table 3 and shed additional light on the nuance of changes in older adults' core discussion networks: they include significantly more non-kin ties, particularly across time period and with age, with less conclusive patterns among changes in kin ties (see Table A2 in the Appendix). We interpret these results in the context of those in Table 3 below.

4. Discussion

This study aimed to examine changes in the kin-centricity of older adults' core discussion networks with age (*Research Question 1)*, by historical period (*Research Question 2*), and across cohorts (*Research Question 3*)—confounding temporal effects that researchers agree are difficult to disentangle (Fosse and Winship, 2019; Glenn, 2005). We draw from established, yet disparate streams of research to motivate our analyses along these lines of inquiry, rather than aim to formally test hypotheses or specific mechanisms. To do so, we combine a classic method with design-based estimates to estimate moderated age-period differences in core discussion networks. We then rely on post hoc tests of predicted means from fully adjusted regression models, then convert these to Pearson Correlation Coefficients to ease interpretability of these differences across network characteristics, as well as to illustrate the relative magnitudes of age, period, and cohort differences in general and across each network dimension. A subsequent series of post-hoc Wald tests provided higher-level insights into which APC dimension(s) are relatively more important in shaping network changes across *all age bins*.

We note that, overall, correlation coefficients presented in our main results are substantively small. Nonetheless, when coupled with differences in conditional means (Table A1) and regression results (Table 4), this descriptive approach to understanding patterns in changes in the kin-centricity of older adults' core discussion networks yields several interesting findings. One, our results are not easily predicted by one of the singular frameworks that has frequently been used for understanding how or why older US adults' networks change over time. For example, extensive social network and gerontology research draws on the life course approach to suggest that networks become smaller and more kin-centric as adults continue to age (*Research Question 1: age effects*). Here, we found that US adults' core discussion networks became larger and more diverse with age, and, to some extent, became less kin-centric, particularly among the young-old. In addition, period approaches to understanding network change are vastly understudied. Two potential sources discussed in current research relate to the Great Recession and technological advances. Although we do not test these mechanisms, these perspectives suggest that older adults' confidant networks may simultaneously have grown more kin-centric and more diverse between 2005/06 and 2015/16 (*Research Question 2: period effects*). Similar to the age effect, we found that adults' core discussion networks increased in size and range, and this is true for most 10-year age bins, and became less kin-centric among all but those in their 80s (again, the latter is negligible). That we are unable to test these mechanisms begs for consideration of alternative explanations. For example, geographic mobility and policy change, such as the 2010 Affordable Care Act and TANF, may also help explain changes in intergenerational relationships during the last decade (Fingerman, Huo, and Birditt 2020). Nevertheless, these findings do support our examination of period-driven trends. Last, cohort approaches are similarly lacking in existing scholarship. Family demography research suggests that later-born cohorts would have larger, more diverse, and less kin-centric networks than earlier-born cohorts (*Research Question 3: cohort effects*). Our findings suggest that later-born cohorts had more diverse core discussion networks and co-resided with more kin network members than earlier-born cohorts, with stronger differences observed in 2015/16 than in 2005/06 and only among select age bins. Again, we cannot test these mechanisms, nor can we necessarily ascribe them to one APC dimension more than another. For example, it is possible that later-born cohorts have adopted technological advances before earlier-born cohorts. Over time, the older cohorts caught up, suggesting some larger cultural shifts may be occurring along *both* period and cohort lines, such as changes in filial-related norms and attitudes toward individualization (e.g., Ang, 2022; Fingerman et al., 2012). Indeed, simultaneous estimation of multiple time-varying dimensions paints a far more comprehensive, nuanced picture than only considering singular patterns of change and provides an important foundation for future work.

Two, our results provide new insight into the broader social context in which changes in family relationships occur. Specifically, extant research often focuses on specific dyadic relationships (e.g., parent-child) (Carr and Utz 2020; Seltzer 2019). This makes sense, given the key role that these familial ties play in providing social support for older adults, in large part due to enduring kinship norms and expectations (Offer 2021). Implicit, however, is the assumption that such kin ties are inherently beneficial, or characterized by high quality interactions and frequent support, despite recent scholarship that suggests otherwise (Schafer and Sun, 2021). Compounding this limitation is that exclusive emphasis on familial ties fails to capture concurrent trends in non-kin relationships. This is a critical omission as studies consistently document the importance of non-kin ties in individuals' health and well-being (e.g., Burt, 2005; Marsden, 2018). In using core discussion networks as a lens for examining age-period-cohort differences in the kin-centricity of older adults' personal networks, we examine who they perceive to be their most important network ties, allowing for inclusion of both kin and non-kin. In doing so, we characterize changes in older adults' core discussion network structure and composition, both generally (size and diversity) and specific to family (co-residing family, percent of network that is kin).

Indeed, we find that older adults' core discussion networks became larger and more diverse, both between 2005/06 and 2015/16 (period), and with age. Importantly, these networks became less kin-centric along these same period and age dimensions, suggesting that additions or maintenance of non-kin rather than kin ties accounted for these changes; this is consistent with results from supplemental analyses (Table A2), which suggest an increase in the *number of non-kin* with less conclusive changes in the *number of kin* network members. Although we cannot test the specific mechanisms driving these patterns, existing research provides useful

frameworks for speculation. For example, this pattern may be driven by older adults' adoption of technology and virtual modes of communication, thereby facilitating social engagement with a range of relationship types, regardless of geographic location (Wellman and Wortley 1990). Indeed, theories of network individualism posit a new age in which a personalized internet and ever-present mobile connectivity enable individuals to expand their networks beyond households and neighborhoods (Ang, 2022; Rainie and Wellman, 2012). Moreover, that these trends in network size and range emerge among the oldest-old suggests that those in their 80s may be benefitting from these technologies, as well as community programs aimed at reducing social isolation among older adults (Khosravi et al., 2016; Dickens et al., 2011). At the same time, the decline in *percent network that is kin* occurs among those in younger age bins, which may point to those aging into their 60s and 70s gaining more non-kin ties in years in which they are retired and remain physically and cognitively healthy. This is consistent to some extent with our observed cohort effects: later-born cohorts had larger, more diverse networks, although these trends were less conclusive. In light of the dominant socio-emotional selectivity theory, it is also possible that older adults are simply expanding, then maintaining, more diverse core discussion networks due to both the declining presence of kin and their enhanced ability to remain connected with non-kin—an increase in "fictive kin" ties. Whether they prune these ties to focus on those most central in their later years, or those in their broader network, is unclear. That later-born cohorts also lived with more kin core discussion network members than did earlier-born cohorts may also reflect their more favorable attitudes toward cohabitation or remarriage in later life after losing a spouse or divorcing (Brown and Wright, 2016).

Finally, post hoc Wald tests for model fit allow us to make inferences about what these changes might mean for older adults in the coming decades. Age significantly improved model fit for models predicting the *number of co-residing kin network members* (declined with age) and for *network range* (increased with age). These patterns suggest that, as the world's population continues to age, the number and prevalence of older adults who live with fewer or no kin network members will increase. However, this may not be particularly problematic if they experience concurrent growth in network diversity, which may buffer against declines in social support previously provided by co-residing kin, or even provide increased protection against cognitive decline (Kotwal et al., 2016; Sharifian et al., 2019). Historical period improved model fit for *network size* (increased between 2005/06 and 2015/16), *network range* (also increased), and *percent network that is kin* (decreased). Although we do not test specific mechanisms, these trends are telling: older adults in all but the oldest-old age bins experienced these two historical periods of time differently with regard to their core discussion networks, both generally (size, range) and specifically for family (kin-centricity). That they grew in size and range and became less kin-centric is consistent with illustrative perspectives on technology and family structure: older adults may have adopted new technologies over these 10 years, a time of rapid technological advancement and availability (Hunsaker and Hargittai 2018). That this has coincided with continued diversity in American families, as well as new manners in which kin ties are negotiated and constructed within a larger context of processes of individualization, it is possible these trends will continue into the coming decade, and perhaps even accelerate given documented COVID-19 trends (Allan et al., 2001; Haase et al., 2021; Popenoe, 1993; Hawkley et al., 2021). This continued increase in digital connectivity and an emphasis on non-kin ties or "families of choice" likely has implications for today's alarming patterns of social isolation and loneliness, both enhancing social connection while also requiring added effort to maintain ties (Ang, 2022; Pahl and Spencer, 2004; Rainie and Wellman, 2012; Pescosolido and Rubin, 2000).

Several limitations are important to consider. While we focus on the later period of the life course as a time of consequential social change in individuals' lives, APC effects on core discussion network kin-centricity across other periods of the life course (e.g., early and mid-adulthood), and across cohorts and periods that span wider intervals of time are key topics for future studies. For example, future rounds of the NSHAP could help examine whether period effects, such as the COVID-19 pandemic and larger shifting norms potentially not captured over our 10-year observation period, have led to more emphasis on use of technology/remote communication, and how this influenced older adults' core discussion networks. Continuing to observe network changes among later-born cohorts may also reveal a stark decline in the *lack of available kin ties* given demographic trends in life expectancy, fertility, and marriage. Social network kin-centricity and changes in family ties more broadly also differ in significant ways across social groups (Fischer and Beresford 2015; Ajrouch et al. 2001). Additional work to disaggregate APC patterns in core discussion network kin-centricity by gender, social class, and racial/ethnic group can shed additional light on how certain dimensions of temporal change are more or less influential on the broader personal networks of different demographics of older adults (e.g., Chua, 2013).

The "important matters" name generator has been critiqued with respect to reliability and validity (e.g., Bearman and Parigi, 2004; Fischer 2009; Small, 2013), including the possibility that important kin and non-kin may not appear in older adults' core discussion networks. We recognize that our analyses pertain largely to the core discussion network, and cannot be extended to claims about APC trends in social ties more broadly or to other dimensions of personal networks. Indeed, different name generators that are specific to various forms of social support (e.g., instrumental) could yield a more kin-centric portrait of older adults' social lives than that elicited by the "important matters" name generator alone. At the same time, the core discussion networks may not capture the full set of older adults' discussion partners, as respondents may discuss important issues with kin (and non-kin) who are not named as core discussion alters (Small, 2013). Core discussion networks also represent a snapshot of a given point in time, and can change over time to include kin and other confidants who represent well known social ties (Offer and Fischer, 2022). The present study focused on cross-sectional analyses to optimize age bin comparison across time periods, with age, and between cohorts, although within-person analyses can shed further light on network dynamics in an APC framework. Importantly, consistent administration of the "important matters" name

generator across survey rounds mitigate issues in comparing network measures across periods (Cornwell et al., 2021) and of interviewer effects and measurement error in data collection (Paik and Sanchagrin, 2013), respectively. Furthermore, the NSHAP includes only community-dwelling older adults. While beyond scope of this study, institutionalized older adults, particularly those in nursing homes or assisted care facilities, may have smaller networks, and largely kin-based, given caretaking obligations and reduced opportunities to foster non-kin ties. Engagement in organized group activities, religious service attendance, and volunteering are not the focus of this analysis, but may exhibit differences along age, period, and cohort in ways that have implications for the salience of kin in older adults' social lives. Lastly, future research is needed to test specific age-, period-, and/or cohort-driven sources of these changes, such as technology or changes in filial norms.

4.1. Conclusion

In sum, our analysis sheds new light on the widely studied question of how family relationships change in the US, using core discussion networks as the lens for examining age, period, and cohort differences in older adults' social lives. Given current trends in extending life expectancy, declining fertility, increased mobility, financial insecurity, declining marriage rates, and technological adoption, results suggest older adults' confidant networks will remain robust and continue to emphasize non-kin ties. This descriptive approach provides an important foundation for future work on understanding the intersection of both personal and macro-level influences driving the kin-centricity of social networks over time, both of which have important implications for health and well-being in later life.

CRediT authorship contribution statement

Ellen L. Compernolle: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Conceptualization. **Alyssa Goldman:** Writing – review & editing, Writing – original draft. **Eric C. Hedberg:** Visualization, Methodology, Formal analysis.

Author Note

The authors do not have any conflicts of interest to declare.

Author contributions

E. Compernolle cleaned the data and E. Compernolle and E. Hedberg performed all statistical analyses. E. Compernolle and A. Goldman wrote the manuscript. All authors aided in the interpretation of the findings and edited and approved the final manuscript.

Table A1
Conditional predicted means of 10-year age bins in 2005/06 and 2015/16 from linear regression models predicting older adults' core discussion network characteristics with differences in means along age, period, and cohort lines

Network size							**# Co-residing kin network members**						
Age Cat	**2005**	**2015**	**Period**	**Age**	**Cohort (2005)**	**Cohort (2015)**	**Age Cat**	**2005**	**2015**	**Period**	**Age**	**Cohort (2005)**	**Cohort (2015)**
age 51 to 60	**3.61**	**3.95**	0.35***				age 51 to 60	**0.70**	**0.71**	0.01			
age 61 to 70	**3.48**	**3.77**	0.29***	0.16*	-0.13	-0.18*	age 61 to 70	**0.62**	**0.65**	0.03	-0.06	-0.09**	-0.06
age 71 to 80	**3.49**	**3.96**	0.47***	0.48***	0.01	0.19**	age 71 to 80	**0.54**	**0.58**	0.04	-0.04	-0.08***	-0.07**
age 81 to 90	**3.51**	**3.85**	0.35**	0.36***	0.02	-0.11	age 81 to 90	**0.55**	**0.50**	-0.05	-0.04	0.01	-0.08*

Network range							**% Network is kin**						
Age Cat	**2005**	**2015**	**Period**	**Age**	**Cohort (2005)**	**Cohort (2015)**	**Age Cat**	**2005**	**2015**	**Period**	**Age**	**Cohort (2005)**	**Cohort (2015)**
age 51 to 60	**2.57**	**2.79**	0.22**				age 51 to 60	**0.67**	**0.60**	-0.07**			
age 61 to 70	**2.32**	**2.59**	0.26***	0.02	-0.25***	-0.20**	age 61 to 70	**0.67**	**0.64**	-0.04*	-0.04*	0.00	0.04
age 71 to 80	**2.26**	**2.57**	0.31***	0.25***	-0.07	-0.01	age 71 to 80	**0.68**	**0.64**	-0.04*	-0.03**	0.00	0.00
age 81 to 90	**2.30**	**2.42**	0.11	0.16*	0.05	-0.16*	age 81 to 90	**0.70**	**0.65**	-0.05	-0.03	0.02	0.01

Notes: Results are from four separate fully adjusted linear regression models that account for the NSHAP's survey design and are weighted using the ACS. Bolded values indicate average marginal effects for specific age bins in a particular period for a respective network characteristic. Results indicate differences in these means, by year (i.e., along horizontal lines), age (i.e., along diagonal), and cohort (i.e., along vertical, for both 2005/06 and 2015/16). *$p < .05$; **$p < .01$; ***$p < .001$.

Table A2
Conditional predicted means of 10-year age bins in 2005/06 and 2015/16 from linear regression models predicting the number of kin (top-most rows) and non-kin (bottom-most rows) named in older adults' core discussion networks with differences in means along age, period, and cohort lines (left-most columns) and converted into Pearson Correlation Coefficients (*r*) (right-most columns)

# Kin in network: average marginal effects							# Kin in network: correlation coefficients						
Age Cat	**2005**	**2015**	**Period**	**Age**	**Cohort (2005)**	**Cohort (2015)**	**Age Cat**	**2005**	**2015**	**Period**	**Age**	**Cohort (2005)**	**Cohort (2015)**
age 51 to 60	**2.43**	**2.35**	-0.08				age 51 to 60	**2.43**	**2.35**	-0.06			
age 61 to 70	**2.29**	**2.37**	0.08	-0.06	-0.14	0.02	age 61 to 70	**2.29**	**2.37**	0.05	-0.04	-0.10	0.01
age 71 to 80	**2.32**	**2.48**	0.16*	0.19***	0.03	0.12	age 71 to 80	**2.32**	**2.48**	0.11	0.14	0.02	0.08
age 81 to 90	**2.42**	**2.40**	-0.02	0.07	0.09	-0.09	age 81 to 90	**2.42**	**2.40**	-0.01	0.05	0.07	-0.06

# Non-kin in network							# Non-kin in network						
Age Cat	**2005**	**2015**	**Period**	**Age**	**Cohort (2005)**	**Cohort (2015)**	**Age Cat**	**2005**	**2015**	**Period**	**Age**	**Cohort (2005)**	**Cohort (2015)**
age 51 to 60	**1.25**	**1.64**	0.39***				age 51 to 60	**1.25**	**1.64**	0.32			
age 61 to 70	**1.24**	**1.46**	0.22***	0.21**	-0.01	-0.18*'	age 61 to 70	**1.24**	**1.46**	0.18	0.17	-0.01	-0.15
age 71 to 80	**1.23**	**1.52**	0.28***	0.28***	-0.01	0.06'	age 71 to 80	**1.23**	**1.52**	0.23	0.23	-0.01	0.05
age 81 to 90	**1.15**	**1.49**	0.35**	0.26**	-0.09	-0.02'	age 81 to 90	**1.15**	**1.49**	0.29	0.22	-0.07	-0.02

Notes: Results are from two fully adjusted linear regression models that applies post-stratification survey weights using the ACS data from 2005 to 2015. Bolded values indicate average marginal effects for specific age bins in a particular period for the number of kin or non-kin named in an older adult's core discussion network. Results in the left-most columns indicate differences in these means, by year (i.e., along horizontal lines), age (i.e., along diagonal), and cohort (i.e., along vertical, for both 2005/06 and 2015/16). *$p < .05$; **$p < .01$; ***$p < .001$. Shaded values in the right-most columns indicate differences in these means, converted to correlation coefficients (*r*), by year (i.e., along horizontal lines), age (i.e., along diagonal), and cohort (i.e., along vertical, for both 2005/06 and 2015/16). Darker shading indicates larger correlations; red shades indicate negative correlations and blue shades, positive.

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