UNIVERSITY OF CALIFORNIA,
IRVINE

Is Variety More Important than Quantity? Diversity versus Number of Social Ties Predicting Later Life Health and Leisure Activity

THESIS

submitted in partial fulfillment of the requirements
for the degree of

MASTER OF ARTS

in Social Ecology

by

Colette Brown

Thesis Committee:
Distinguished Professor Emerita Karen S. Rook, Chair
Professor and Department Chair Susan T. Charles
Assistant Professor of Teaching Amy L. Dent

2020

TABLE OF CONTENTS

ACKNOWLEDGEMENTS

I would like to thank my committee members for their invaluable guidance and expertise, as well as my cohort members for moral support along the way. Surveys were conducted by Harris Interactive, Inc. Funding for the Later Life Study of Social Exchanges, which served as the source of the data for the current study, was provided by a grant from the National Institute on Aging (AG14130).

ABSTRACT OF THE THESIS

Is Variety More Important than Quantity? Diversity versus Number of Social Ties Predicting Later Life Health and Leisure Activity

by

Colette Brown

Master of Arts in Social Ecology

University of California, Irvine, 2020

Distinguished Professor Emerita Karen S. Rook, Chair

A prevailing view exists in the literature that having a variety of relationship types (i.e., diverse social ties) is more consequential for health and activity than the sheer number of social ties. Empirical tests of that claim are relatively scarce, however, and relationship quality is rarely taken into account. The current study contrasted the implications of number and diversity of positive, as well as ambivalent, social ties for functional limitations and leisure activity in later life. Participants (N = 874) were part of the Later Life Study of Social Exchanges (LLSSE), a longitudinal study of a nationally representative sample of older adults ages 65 to 91 (M = 74.12 years old, SD = 6.64). Baseline data from in-person interviews were examined in a series of hierarchical regression models. Number of ties was a more consistent predictor of functional limitations than was diversity of ties (albeit in opposite directions for positive and ambivalent ties), but they did not significantly differ in terms of magnitude. Number of positive ties was a significantly stronger predictor of leisure activity compared to diversity of positive ties, whereas ambivalent ties were not related to leisure activity. Contrary to prevailing views, these findings suggest that variety is not necessarily more important than quantity. Rather, a greater number of positive social ties may be most important for older adults' health and activity.

Is Variety More Important than Quantity? Diversity versus Number of Social Ties Predicting Later Life Health and Leisure Activity

Evidence demonstrating the power of social relationships to influence health outcomes has grown substantially across the past three decades (Holt-Lunstad, Smith, & Layton, 2010). This influence is particularly important in later life because a lack of social support is associated with many health issues experienced by older adults, including declines in physical functioning (Mendes de Leon, Glass, & Berkman, 2003), disability development (Avlund, Lund, Holstein, & Due, 2004), and worse recovery after hospitalization (Fekete, Stephens, Druley, & Greene, 2006). Social relationships also play a vital role in promoting engagement in meaningful leisure activities, an integral component of successful aging (Rowe & Kahn, 1997; Menec, 2003; Lee & Payne, 2015). Remarkably, the magnitude at which social relationships influence mortality risk is comparable to smoking cessation and surpasses other well-known risk factors such as obesity (Holt-Lunstad et al., 2010).

In particular, structural aspects of social relationships – namely, having large and diverse social networks – may better predict mortality than functional aspects such as receiving social support (Holt-Lunstad et al., 2010; Ellwardt, van Tilburg, Aartsen, Wittek, & Steverink, 2015). Recent literature has increasingly emphasized the importance of having a variety of types of social ties as the key to good health and activity engagement (e.g., Berkman, Glass, Brisette, & Seeman, 2000; Fingerman, Huo, Charles, & Umberson, 2019), even though comparisons between number and diversity of social ties have rarely been directly tested. Furthermore, much of this literature implicitly assumes that all social ties are exclusively positive (Holt-Lunstad et al., 2010), without accounting for potentially mixed or ambivalent relationship qualities. Deeper examination is needed, therefore, to determine whether diversity of social ties is indeed a

stronger predictor of health and leisure activity in later life compared to number of social ties, and to do so within the context of relationship quality.

A Closer Look at the Importance of Diversity of Social Ties

Diversity of social ties is broadly conceptualized as having a range of different types of social ties, although its operationalization has differed across studies. Some studies examine diversity as a range of both close (e.g., family and friends) and peripheral (e.g., acquaintances) ties (e.g., Fingerman et al., 2019). Others have examined diversity as a range of both kin and non-kin ties (e.g., Keller-Cohen, Fiori, Toler, & Bybee, 2006). Most commonly – and the definition adopted in the current study – diversity of social ties is operationalized as participation in a range of role relationships (e.g., spouse/partner, friends, children; Cohen, Doyle, Skoner, Rabin, & Gwaltney, 1997). A central issue in this literature that is intertwined with measurement approaches is whether diversity is more important than sheer number of social ties, particularly with regard to older adults' physical health and leisure activity.

Diversity of social ties and physical health. An influential study by Cohen et al. (1997) in which healthy volunteers (ages 18 to 55) were exposed to a cold virus revealed that the association between diversity of social ties and cold susceptibility was not diminished after controlling for number of ties. Number of ties was unrelated to susceptibility to the common cold. Accordingly, the authors concluded that diversity of ties matters most for health rather than the sheer number of ties. For example, a person with seven social ties that reflect three different role relationships (e.g., spouse/partner, friends, children) would be expected to have better health than someone with seven social ties that reflect only one role (e.g., friends). Since this seminal study, however, there has been no replication of this comparison between number and diversity of social ties in older age groups or with regard to other health outcomes besides cold

susceptibility. One study showed that number and diversity of social ties are both significantly related to mortality risk among older adults (Ellwardt et al., 2015). This study did not directly compare the relative magnitude of each effect, however. Numerous other studies have demonstrated the benefits of having diverse social ties (e.g., Fiori, Smith, & Antonucci, 2007; Fingerman et al., 2019), but do not necessarily demonstrate that diversity contributes to health above and beyond the sheer number of social ties. The existing literature has seldom reported analyses structured to examine this specific issue. Therefore, one goal of the current study was to examine whether number or diversity of social ties is a better predictor of health in later life. If diversity of social ties is indeed found to be uniquely important beyond the sheer number of social ties, it might imply that intervention strategies aimed at increasing older adults' number of ties would be less effective than strategies aimed at increasing their diversity of ties.

Diversity of social ties and leisure activity. The importance of social relationships for leisure activity has been well established through nearly 50 years of research in sociology, psychology, and aging (Field & O'Leary, 1973; Glancy & Little, 1995; McDonough, 2013). Engaging in meaningful leisure activity is an integral component of successful aging, as it is related to greater happiness and reduced mortality among older adults (Rowe & Kahn, 1997; Menec, 2003; Lee & Payne, 2015). Older adults are more likely to engage in leisure activities with a high social component (Lee & Payne, 2015), and social support has been documented as a key factor in helping older adults maintain active lifestyles (Chang, Wray, & Lin, 2014; Franke et al., 2013; Sasidharan, Payne, Orsega-Smith, & Godbey, 2006). Less is known, however, about how diversity of social ties relates to leisure activity in later life.

Leisure activities are broadly defined as enjoyable activities engaged in voluntarily during one's free time, such as hobbies, traveling, entertainment, or social visits (Kelly, 1996;

Adams, Leibbrandt, & Moon, 2011). Researchers have speculated that diverse social ties provide greater opportunities for social experiences (Cohen & Lemay, 2007); stimulate novel and varied conversations (Keller-Cohen et al., 2006); and enable greater freedom to choose non-obligatory activities and voluntarily participate in desirable social roles (Fiori et al., 2007). Many of these speculations resemble defining features of leisure activity. Thus, assessing leisure activity as an outcome variable might allow for a test of the logic that diverse social ties encourage more experiences in the world.

As these speculations continue to pique interest in the literature, a few studies have sought to test these predictions directly. In a recent study using ecological momentary assessment, Fingerman et al. (2019) found that older adults who interacted with a wider variety of close and peripheral ties engaged in a greater variety of daily behaviors (including leisure activities) and spent less time being sedentary within a given three-hour period than did older adults who interacted with fewer social ties throughout the day. These data, however, were not structured to examine whether the increase in activity was indeed due to the diversity, as opposed to the sheer number, of participants' social contacts. The distinction between number and diversity of social ties is particularly important with respect to leisure activity because activity-based interventions often involve social components, which could be optimized through targeting specific social relationship aspects.

It warrants noting, however, that considerable variation exists in how leisure activities have been operationalized. For instance, Chang et al. (2014) included productive activities, such as doing household chores, in their measurement of leisure activities. Fingerman et al. (2019), on the other hand, pooled leisure activities (e.g., reading/puzzles) and activities of daily living (e.g., bathing/getting dressed) into a single measure of daily behaviors. Neither household chores nor

personal hygiene seem to fit Kelly's (1996) conceptual characterization of leisure as activities elected for enjoyment. Therefore, the current study will focus on leisure activities that are more likely to be freely chosen and undertaken for enjoyment or meaning.

Leisure activities are not always associated with exclusively positive social ties, however. Obligatory or unwanted social contacts might also prompt leisure participation (Coleman & Iso-Ahola, 1993). For example, obligations to in-laws might prompt family gatherings. Yet it is also possible that people prefer to limit or avoid leisure activities with such ties, in which case certain types of social ties may be associated with less, rather than more, leisure activity. Therefore, an additional goal of the current study was to examine whether the links between number and diversity of social ties and leisure activity may differ depending on relationship quality.

Positive and Ambivalent Social Ties: An Overlooked Aspect of Diversity of Social Ties

Much of the literature linking diverse social networks to better health and activity implicitly assumes that all social ties are positive and exclusively sources of support, a concern that has also been noted by previous researchers (Holt-Lunstad et al., 2010). Other research suggests that this is not the case, with negative social ties contributing to greater mortality risk (Friedman et al., 1995). Research that distinguishes between positive and negative social ties has gained traction in recent years, although researchers seldom posit that the diversity of negative ties is uniquely consequential for health and activity. Even less attention has been paid to social ties that contain a mix of positive and negative qualities. Ties that serve simultaneously as sources of support and conflict have been termed ambivalent ties in the literature (Uchino, Holt-Lunstad, Smith, & Bloor, 2004; Rook, Luong, Sorkin, Newsom, & Krause, 2012), and it is plausible that the sheer number and diversity of ambivalent ties might have distinctive consequences for health and activity.

Studies of social network diversity typically probe for positive, but not negative, relationship aspects. Thus, these studies may unintentionally include some ambivalent ties in their overall assessment of participants' social ties. Participants might mention these "mixed" ties in their reports of network members who provide various kinds of social support, with the ambivalent nature of these ties undetected by researchers. Indeed, social support and conflict are not mutually exclusive, and treating them as such may obscure associations between social relationships and health-related outcomes (Uchino et al., 2004). One previous study found no evidence that positive components of ambivalent ties benefited older adults' psychological well-being (Rook et al., 2012). Moreover, having a greater number of ambivalent ties has been associated with worse physical health among older adults, including higher blood pressure (Holt-Lunstad, Uchino, Smith, Olson-Cerny, & Nealey-Moore, 2003), more rapid cellular aging (Uchino et al., 2012), and greater functional limitations (Rook et al., 2012). Therefore, number and diversity of ambivalent ties should be methodologically separated from those of exclusively positive ties to determine their unique associations with health and activity in later life.

The literature assessing the diversity of social ties has seldom examined ambivalent ties, despite the fact that they are not rare. Studies have estimated that as many as 27% of older adults' ties are ambivalent (Fingerman, Hay, & Birditt, 2004). Furthermore, older adults' ambivalent ties tend to be close family members (Fingerman et al., 2004), making them harder to avoid and allowing more opportunities for them to influence health and activity. An additional goal of the current study, accordingly, was to distinguish number and diversity of ambivalent ties from that of positive ties, and contrast their implications for older adults' physical health and leisure activity.

Current Study

Research has increasingly emphasized the importance of having diverse social ties in later life. The question of whether number and diversity exhibit unique associations with health and leisure activity, however, has not been sufficiently tested. Furthermore, research on network diversity has seldom taken into account differences between positive and ambivalent ties. The current study examined number versus diversity of social ties, for both positive and ambivalent ties, in order to unpack their differential associations with physical health and leisure activity in later life.

We chose to examine functional limitations (i.e., extent of difficulty in carrying out routine daily tasks such as bathing and making meals) as our physical health outcome because daily functioning is crucial to older adults' ability to live independently and live well. We hypothesized that a greater number and diversity of positive ties would predict fewer functional limitations. In contrast, we hypothesized that a greater number and diversity of ambivalent ties would predict greater functional limitations. Additionally, we sought to examine whether diversity was more strongly related to health than number of ties (albeit in opposite directions for positive and ambivalent ties), as is suggested by the existing literature.

We also examined associations of these social network variables with leisure activity, as another key indicator of living well in later adulthood. We hypothesized that a greater number and diversity of positive ties would predict more frequent leisure activity. Our investigation of the associations between number and diversity of ambivalent ties with leisure activity was exploratory, given the conflicting arguments for the direction of this association. Finally, we sought to examine whether diversity of social ties was more strongly related to leisure activity

than number of ties, and if so, whether this distinction mattered for positive ties as well as ambivalent ties.

Method

Sample

Participants were part of a larger study sample from the Later Life Study of Social Exchanges (LLSSE), a 2-year, 5-wave, national longitudinal survey of older adults (see Sorkin & Rook, 2004). Probability sampling was used to select a representative sample of older adults, age 65 and older, living in the coterminous United States. All study participants were noninstitutionalized, English-speaking, and cognitively functional. Participants were randomly selected from a 5% sample of the Medicare Beneficiary Eligibility List provided by the Centers for Medicare and Medicaid Services. This list includes all older adults in the U.S., regardless of Social Security benefit status; however, no information is released for individuals over 100 years old and non-legal residents. Participants received an initial invitation by mail, followed by a phone call or in-person visit. Of those who could be contacted and met eligibility criteria, 53% consented to participate in the study.

At baseline, the total sample consisted of 916 adults ages 65 to 91 (M = 74.16 years old, SD = 6.63; 62% female, 38% male). The sample was primarily non-Hispanic White (83%), with 11% African American, 5% Hispanic or Latinx, and approximately 1% identified as belonging to another racial minority group (e.g., Asian, Native American). Slightly over half (54%) of participants were married, 34% were widowed, 8% were divorced, and 4% were never married. About a quarter (27%) of participants reported less than a high school education, 36% completed high school, and 37% completed education beyond high school (e.g., vocational school, college).

This sample closely resembled the older adult (65+) U.S. population based on 2000 census data (U.S. Census Bureau, 2002).

Procedure

The current study used data from the in-person interviews (lasting approximately 70 minutes each) conducted at baseline. The interview included questions about demographic characteristics, social relationships and exchanges, physical health, and leisure activities. Questions were read to the participant, with the interviewer recording their responses. Most item response options used a standard Likert-type scale. The data were collected by Harris Interactive, Inc. (Rochester, NY), a major survey research firm with extensive experience conducting public polls and social science surveys, including with older adults.

Measures

Social network predictors. We used a two-step process to identify social network members who functioned as positive or ambivalent ties. First, 24 items assessed the frequency of participants' positive and negative social exchanges over the past month (see Newsom, Rook, Nishishiba, Sorkin, & Mahan, 2005 for additional information about this measure). Twelve items assessed four domains of positive exchanges (three items per domain): emotional support, instrumental support, informational support, and companionship. Twelve additional items assessed four corresponding domains of negative exchanges (three items per domain): insensitivity or criticism by others, let down in times of need, unwanted or unsound advice, and rejection or neglect by others.

In the second step, we adapted a method of social network elicitation initially developed by McCallister and Fischer (1978). Following each domain of social exchanges, participants were asked to provide names (first name, last initial) of people who were involved with those

exchanges. Based on the pattern of exchanges reported, researchers classified participants' social ties as positive (i.e., people named only for positive exchanges) or ambivalent (i.e., people named for both positive and negative exchanges). *Number of positive ties* was obtained by counting the number of positive ties, and *number of ambivalent ties* was obtained by counting the number ambivalent ties. The current study did not examine negative ties because they were extremely rare, comprising only 8% of participants' social ties, on average. Moreover, our study aim was to contrast the number and diversity of social ties exhibiting positive relationship qualities, and the diversity of purely negative ties has not been posited to benefit health or leisure activity. Whether diverse negative ties harm health and well-being to a greater extent than does number of negative ties is an interesting question that is beyond the scope of the current study.

Scores for diversity of social ties was obtained using a slightly adapted version of Cohen's Social Network Index (Cohen et al., 1997). Following the social network elicitation, participants were also asked to report on the nature of the role relationship with each network member. Network members were classified into 13 distinct role relationships: spouse/partner, adult children, siblings, parents, grandchildren, other relatives, in-laws, friends, neighbors, co-workers, acquaintances, home aides, or other non-relatives. One point was assigned for each role relationship in which participants had at least one positive tie, yielding a score for *diversity of positive ties*. One point was assigned for each role relationship in which participants had at least one ambivalent tie was reported, yielding a separate score for *diversity of ambivalent ties*.

Functional limitations. Functional limitations were assessed using a 15-item self-report scale about basic activities of daily living (e.g., bathing; Katz et al., 1963), instrumental activities of daily living (e.g., managing finances; Lawton & Brody, 1969), upper extremity strength (e.g., lifting 15-pound objects; Nagi, 1976), and mobility (e.g., climbing stairs; Rosow & Breslau,

1966). Participants indicated how difficult it would be for them to do each activity by themselves, using a response scale of 0 (*Not At All Difficult*) to 3 (*Very Difficult*). All items were summed and averaged, with higher scores indicating greater functional limitations. Internal consistency was strong (Cronbach's $\alpha = .92$).

Leisure activity. Frequency of leisure activity was assessed using a self-report scale with nine items that resemble those used in previous studies of leisure activity among older adults (cf., Adams et al., 2011). The scale included activities that are likely to be freely chosen and undertaken for enjoyment or meaning (i.e., attend meetings of clubs/organizations, get together/talk on the phone with friends, get together/talk on the phone with family, work on a hobby, play cards/bingo/similar games, go out to a movie/restaurant/sporting event, go out shopping, go on trips, and do volunteer work). Participants were asked how often in the past month they did each activity. Response options ranged from 0 (*Never*) to 5 (*Daily*). All items were summed and averaged, with higher scores indicating more frequent leisure activity. Internal consistency was moderate (Cronbach's $\alpha = .62$), which is to be expected given that participation in leisure activities may not be correlated in consistent ways (Adams et al., 2011).

Covariates. We adjusted for several factors associated with our social network predictors or health and activity outcomes: age, sex, education, and number of chronic health conditions (up to 12 health conditions; e.g., hypertension, arthritis, diabetes). These demographic variables were found to be associated with our predictors or outcomes of theoretical interest. Additionally, previous research has identified age-related changes in social network characteristics (Charles & Carstensen, 2010), health, and leisure participation (Lampinen, Heikkinen, Kauppinen, & Heikkinen, 2006); as well as gender and socioeconomic differences in the associations between social participation and health (Agahi & Parker, 2008).

Analytic Strategy

Using a series of hierarchical regression analyses in SPSS, we predicted functional limitations and frequency of leisure activity based on the participants' social network characteristics. We examined number and diversity of social ties together in the same model, as well as in separate models, for both positive and ambivalent ties. To examine whether number or diversity is more strongly related to each outcome, difference tests of dependent correlations were conducted using the bivariate correlation coefficients (Steiger, 1980; Meng, Rosenthal, & Rubin, 1992; Lee & Preacher, 2013). Additionally, we examined whether these differences were robust to the inclusion of covariates by comparing the confidence intervals for each standardized regression coefficient from the separate hierarchical models (Greenland et al., 2016).

Assumptions were assessed using diagnostic tests and visual assessments. Shapiro-Wilk tests indicated that one of the outcome variables, functional limitations, was non-normally distributed ($p < .001$). In large samples, regression analyses are robust to moderate departures from normality. Nonetheless, transformations were explored to evaluate whether the distribution could be improved. Monotonic square-root transformations of functional limitations improved the skewness, but did not improve the visual distribution or the Shapiro-Wilk test. Therefore, we determined that the transformation would not improve the distribution well enough to outweigh the cost of interpretability, and transformations did not seem warranted. No outliers were identified based on a global index of influence (standardized DFFITS < |1| for all participants across all analyses). Assumptions of homoscedasticity and normality of errors in the outcome variables were met. Multicollinearity among predictors was acceptable (VIF ranged from 2.0 to 2.57 across analyses).

Results

Descriptive Information

A total of 42 participants were excluded from all analyses (31 had missing names or relationship codes for their network members, 9 reported having no network members, and 2 had only negative ties), leaving 874 participants included in the current study who reported at least one positive exchange with a network member in the past month. Of these, 574 participants had exclusively positive ties in their network, 20 participants had exclusively ambivalent ties, and 280 participants had both positive and ambivalent ties. Participants with any positive ties in their network (n = 854) had an average of four to five positive ties (observed range = 1 to 17 positive ties) representing two to three distinct role relationships (e.g., spouse/partner, friends), on average (observed range = 1 to 7 role relationships). Participants with any ambivalent ties in their social networks (n = 300) had an average of one to two ambivalent ties (observed range = 1 to 5 ambivalent ties) representing one to two role relationships, on average (observed range = 1 to 4 role relationships). Means, standard deviations, and correlations among all study variables are included in Table 1. With respect to functional limitations, participants' average difficulty across all tasks of daily living was low, but only 20% reported absolutely no difficulty with any tasks. Across all leisure activities, 50% of participants reported engaging in leisure activities at least several times a month on average.

Number Versus Diversity of Social Ties in Predicting Functional Limitations

Positive ties and functional limitations. To examine whether number or diversity of positive ties more strongly predicts functional limitations, a hierarchical regression analysis was conducted among (n = 854) participants with positive ties in their social network (i.e., participants with exclusively ambivalent ties in their network were excluded; see Table 2). The

first block of predictors included the covariates (age, sex, education, and health conditions), and the second block included the two social network predictors of theoretical interest (number and diversity of positive ties). Over and above the covariates, which explained a significant proportion of variation [R^2 = .27, Adj. R^2 = .27, F(4, 845) = 79.46, p < .001], number and diversity of positive ties together significantly increased the proportion of variation explained in functional limitations by .6% [ΔR^2 = .006, ΔF(2, 843) = 3.24, p = .04]. Number of positive ties was a marginally significant unique predictor of functional limitations [b = -.02, 95% CI_{boot} (-.03, -.001), t(843) = -1.90, p = .06], whereas diversity of positive ties was not a significant unique predictor [b = .003, 95% CI_{boot} (-.04, .04), t(843) = .14, p = .87].

A difference test of dependent correlations revealed that the correlation between number of positive ties and functional limitations was marginally stronger than the correlation between diversity of positive ties and functional limitations (Z = -1.92, p = .06). The difference test approach accounts for the association between number and diversity of positive ties, but does not account for covariates.

To examine whether these differences in magnitude were robust to the inclusion of covariates, number and diversity of positive ties were used to predict functional limitations in two separate hierarchical regression models. The first model included covariates in the first block, and number of positive ties in the second block. The second model adopts this same approach, except that its second block included diversity of positive ties (instead of number of positive ties). The purpose of these two additional models was to obtain the separate, standardized regression coefficients for number and diversity of positive ties to ultimately determine whether they statistically differ from each other. For this reason, standardized scores for the social network predictors and outcome variable were used to permit comparison of the

standardized regression coefficients and their confidence intervals (Greenland et al., 2016). When number of positive ties was included as the only predictor in the second block, the proportion of variation explained in functional limitations improved significantly [ΔR^2 = .006, $\Delta F(1, 844) = 6.47$, p = .01]. When diversity of positive ties was included as the only predictor in the second block, the proportion of variation explained in functional limitations improved marginally [ΔR^2 = .002, $\Delta F(1, 844) = 2.86$, p = .09]. However, the confidence intervals for each standardized regression coefficient [β_{number} = -.07, 95% CI_{boot} (-.13, -.02); $\beta_{diversity}$ = -.05, 95% CI_{boot} (-.11, .01)] contained the point estimate of the other, indicating that number and diversity of positive ties did not significantly differ in terms of their ability to predict functional limitations when examined separately (Greenland et al., 2016; see Figure 1).

Ambivalent ties and functional limitations. To examine whether number or diversity of ambivalent ties more strongly predicts functional limitations, a hierarchical regression analysis was conducted among (n = 300) participants with ambivalent ties in their social network (i.e., participants with exclusively positive ties in their network were excluded; see Table 3). The first block included the covariates, and the second block included number and diversity of ambivalent ties. Over and above the covariates, which explained a significant proportion of variation [R^2 = .24, Adj. R^2 = .23, $F(4, 294) = 23.34$, $p < .001$], number and diversity of ambivalent ties together significantly increased the proportion of variation explained in functional limitations by 2% [ΔR^2 = .02, $\Delta F(2, 292) = 3.56$, p = .03]. Number of ambivalent ties was a significant unique predictor of greater functional limitations [b = .16, 95% CI_{boot} (.01, .31), $t(292) = 2.63$, p = .01]. In contrast, diversity of ambivalent ties was a marginally significant unique predictor of fewer functional limitations [b = -.16, 95% CI_{boot} (-.37, .06), $t(292) = -1.76$, p = .08].

A difference test of dependent correlations revealed that the correlation between number of ambivalent ties and functional limitations was significantly stronger than the correlation between diversity of ambivalent ties and functional limitations ($Z = 3.58$, $p < .001$), accounting for the association between number and diversity of ambivalent ties. Next, two separate hierarchical regression models using standardized scores were conducted with the covariates in the first block and either number or diversity of ambivalent ties in the second block. When number of ambivalent ties was included in the second block, the proportion of variation explained in functional limitations improved significantly [$\Delta R^2 = .01$, $\Delta F(1, 293) = 3.99$, $p = .047$]. Conversely, including diversity of ambivalent ties did not significantly improve the variation explained by the model [$\Delta R^2 = <.001$, $\Delta F(1, 293) = 0.18$, $p = .67$]. Despite these differences in *p*-values, the confidence intervals for each standardized regression coefficient [$\beta_{number} = .10$, 95% CI_{boot} (.01, .22); $\beta_{diversity} = .02$, 95% CI_{boot} (-.07, .13)] contained the point estimate of the other, indicating that number and diversity of ambivalent ties did not significantly differ in terms of their ability to predict functional limitations when examined separately (see Figure 2).

Number Versus Diversity of Social Ties in Predicting Leisure Activity

Positive ties and leisure activity. To examine whether number or diversity of positive ties more strongly predicts leisure activity, a hierarchical regression analysis was conducted among participants with positive ties in their social network (see Table 2). The first block included the covariates, and the second block included number and diversity of positive ties. Over and above the covariates, which explained a significant proportion of variation [$R^2 = .12$, Adj. $R^2 = .12$, $F(4, 844) = 29.89$, $p < .001$], number and diversity of positive ties together significantly increased the proportion of variation explained in leisure activity by 6% [$\Delta R^2 = .06$,

$\Delta F(2, 842) = 32.59$, $p < .001$]. Number of positive ties was a significant unique predictor of leisure activity [$b = .06$, 95% CI_{boot} (.04, .09), $t(842) = 5.59$, $p < .001$]. Diversity of positive ties, in contrast, did not uniquely predict leisure activity [$b = .005$, 95% CI_{boot} (-.04, .06), $t(842) = .19$, $p = .85$].

A difference test of dependent correlations revealed that the correlation between number of positive ties and leisure activity was significantly stronger than the correlation between diversity of positive ties and leisure activity ($Z = 5.91$, $p < .001$), accounting for the association between number and diversity of positive ties. Next, two separate hierarchical regression models using standardized scores were conducted with the covariates in the first block and either number or diversity of positive ties in the second block. When number of positive ties was included in the second block, the proportion of variation explained in leisure activity increased by 6.3% [$\Delta R^2 = .063$, $\Delta F(1, 843) = 65.22$, $p < .001$]. Including diversity of positive ties also significantly increased the proportion of variation explained in leisure activity, although to a lesser degree, by 3.3% [$\Delta R^2 = .033$, $\Delta F(1, 843) = 32.81$, $p < .001$]. Additionally, the confidence intervals for each standardized regression coefficient [$\beta_{number} = .251$, 95% CI_{boot} (.194, .308); $\beta_{diversity} = .182$, 95% CI_{boot} (.119, .246)] did not contain the point estimate of the other, indicating that number of positive ties was a significantly stronger predictor of leisure activity, compared to diversity of positive ties (see Figure 1).

Ambivalent ties and leisure activity. To examine whether the number or diversity of ambivalent ties more strongly predicts leisure activity, a hierarchical regression analysis was conducted among participant with ambivalent ties in their social network (see Table 3). The first block included the covariates, and the second block included number and diversity of ambivalent ties. The covariates together explained a significant proportion (6%) of variation in leisure

activity [R^2 = .07, Adj. R^2 = .06, F(4, 293) = 5.79, p < .001]. Adding number and diversity of ambivalent ties as a second block did not significantly improve the proportion of variation explained in leisure activity [ΔR^2 = .01, ΔF(2, 291) = 1.49, p = .23]. Furthermore, number of ambivalent ties was not a significant unique predictor [b = -.10, 95% CI_{boot} (-.27, .06), t(291) = -1.35, p = .18], and diversity of ambivalent ties was only a marginally significant unique predictor of leisure activity [b = .19, 95% CI_{boot} (-.03, .43), t(291) = 1.73, p = .08].

Neither number nor diversity of ambivalent ties was significantly related to leisure activity. After accounting for the association between number and diversity, a difference test of dependent correlations revealed that the relation between number of ambivalent ties and leisure activity was significantly weaker, and in the opposite direction, than diversity of ambivalent ties (Z = -2.29, p = .02). However, when examined in two separate hierarchical regression models using standardized scores, and after inclusion of the covariates, the proportion of variation explained in leisure activity was not significantly improved by entering number of ambivalent ties [ΔR^2 = <.001, ΔF(1, 292) = <.001, p = .98] or diversity of ambivalent ties [ΔR^2 = .004, ΔF(1, 292) = 1.17, p = .28]. Additionally, the confidence intervals for each standardized regression coefficient [β_{number} = -.001, 95% CI_{boot} (-.12, .12); $\beta_{diversity}$ = .06, 95% CI_{boot} (-.04, .17)] contained the point estimate of the other, indicating that number and diversity of ambivalent ties did not significantly differ in terms of their ability to predict leisure activity when examined separately (see Figure 2).

Discussion

A prevailing view exists in the literature that having diverse social ties is more consequential for health and activity than the sheer number of social ties. Empirical tests of that claim are relatively scarce, however, and relationship quality is rarely taken into account. The

present study sought to extend this literature by contrasting number and diversity of social ties, for both positive and ambivalent ties, and their associations with functional limitations and leisure activity in a nationally representative sample of older adults. Number of ties was more a more consistent predictor of functional limitations than was diversity of ties (albeit in opposite directions for positive and ambivalent ties), but their contributions overlapped and did not significantly differ in terms of magnitude. In predicting leisure activity, however, the distinction between number and diversity was more noteworthy, particularly for positive ties. Number of positive ties was a significantly stronger predictor of leisure activity compared to diversity of positive ties, whereas ambivalent ties were not related to leisure activity. Contrary to prevailing views, our findings suggest that diversity of ties is not necessarily more important than number of ties. Rather, having positive social ties, regardless of their diversity, may be most important in later life.

Number Versus Diversity of Social Ties in Predicting Functional Limitations

Positive ties and functional limitations. When number and diversity of positive ties were examined together in the same regression model, they together explained a significant proportion of variation in functional limitations. Yet, their unique associations with functional limitations were either weak (marginal significance for number of positive ties) or non-significant (for diversity of positive ties). These results suggest that number and diversity of positive ties are overlapping constructs, as was demonstrated by their strong positive correlation. After accounting for their correlation in a difference test of dependent correlations, number of positive ties was more strongly associated with functional limitations than was diversity of positive ties. This difference in magnitude, however, was not robust to the inclusion of covariates. When examined in separate hierarchical regression models that included the

covariates, number and diversity of positive ties did not significantly differ in the strength of their associations with functional limitations. Notably, given the goal of the current study, no analyses revealed diversity of positive ties to be more strongly related to functional limitations than number of positive ties.

Together, these findings diverge from those of a study by Cohen et al. (1997), which showed that number of ties was not associated with physical health (specifically, susceptibility to the common cold), and that diversity of ties was associated with physical health after accounting for number of ties in a sample of young to middle-aged adults. Given that network diversity would be expected to be higher in these age groups (e.g., due to active roles in school and/or the workforce), compared to older adults, one might expect the health implications of diversity to be different among older individuals. A recent study found that network size and diversity were each significantly related to mortality risk among older adults (Elwardt et al., 2015), though the relative magnitude of their associations was not examined. Still those findings, like ours, indicate nothing particularly distinct about number and diversity of social ties in terms of their associations with health-related outcomes for older adults.

The lack of evidence for any distinct predictive value of either number or diversity in the present study seems to support previous findings from Holt-Lunstad and colleagues' (2010) meta-analysis, which showed that measures of combined structural aspects of social relationships (e.g., network size and social participation) are the strongest predictors of health, compared to measures of a single aspect (e.g., social participation). Studies in that meta-analysis, however, did not examine "mixed" or ambivalent relationship qualities, which have distinct implications for health and well-being (Uchino et al., 2004). The present study sought to clarify this issue by distinguishing positive ties from ambivalent ties.

Ambivalent ties and functional limitations. When number and diversity of ambivalent ties were examined together in the same regression model, they together explained a significant proportion of variation in functional limitations. Consistent with previous studies demonstrating the adverse health outcomes associated with ambivalent ties (Uchino et al., 2012; Rook et al., 2012), having a greater number of ambivalent ties predicted greater functional limitations. This association was significant after accounting for diversity of ambivalent ties, indicating that there is something unique about the sheer number of ambivalent ties that is related to adverse health outcomes independent of the diversity of ambivalent ties. A puzzling finding was the direction of the unique association between diversity of ambivalent ties and health.

Unexpectedly, we found that greater diversity of ambivalent ties was marginally related to fewer functional limitations, after taking number of ambivalent ties into account. This trend suggests that having more diverse ambivalent ties somehow minimizes their negative associations with health. A possible explanation for the unexpected direction of this association may be that greater diversity of ambivalent ties might reflect a range of close and peripheral ties. Some literature suggests that older adults may be better able to avoid (and are therefore less bothered by) peripheral ambivalent ties (Charles, 2010). In contrast, other research suggests that older adults are better able to regulate negative experiences when they occur with their closest tie, who is most likely harder to avoid, compared to their less close ties (Birditt et al., 2020). Despite these mixed findings in previous literature, they do shed some light on our current findings, suggesting that perhaps it is not the diversity of ambivalent ties that matter, per se, but the perceived closeness of ambivalent ties that matters for health. Considering that the current literature has yet to paint a clear picture, the mixed findings regarding closeness of social ties may also explain the weak association found in our results. Closeness of social ties was not

assessed in the present study, but future research could examine this question.

Also unique to the present study was the statistical comparison of magnitudes of the associations between number and diversity of ambivalent ties and functional limitations. In a difference test of dependent correlations, number of ambivalent ties was more strongly related to functional limitations than was diversity of ambivalent ties. When examined in separate hierarchical regression models that included covariates, a greater number of ambivalent ties significantly predicted greater functional limitations, whereas diversity of ambivalent ties was not related to functional limitations. These additional findings give some traction to our above findings that number (rather than diversity) of ambivalent ties is more consistently predictive of functional limitations. Despite these differences in significance testing, however, the relative magnitude of their associations with functional limitations did not significantly differ after inclusion of the covariates. Again, these latter findings mirror, to some extent, those reported in the study by Elwardt et al. (2015), indicating nothing particularly distinct about number and diversity with regard to health-related outcomes for older adults.

Number Versus Diversity of Social Ties in Predicting Leisure Activity

Positive ties and leisure activity. The distinction between number and diversity of positive ties was more noteworthy for leisure activity than for functional limitations. When number and diversity of positive ties were examined in the same regression model, they together explained a significant proportion of variation in leisure activity. This effect was largely accounted for by number of positive ties, which uniquely predicted greater frequency of leisure activity. In contrast, diversity of positive ties did not exhibit unique explanatory value. These findings challenge conventional wisdom in the literature that participation in a broad range of social roles is the key to an active and healthy lifestyle in later life (see review in Berkman et al.,

2000). Instead, current findings point to the importance of having a greater number of positive ties, even after partialling out diversity. This conclusion was further supported when we examined the relative magnitude of their associations with leisure activity.

In a difference test of dependent correlations, number of positive ties was significantly more strongly related to leisure activity than was diversity of positive ties. When examined in separate hierarchical models that included covariates, a greater number of positive ties predicted greater frequency of leisure activity. Greater diversity of positive ties exhibited a similar significant effect, although to a lesser magnitude. A comparison of the magnitudes of each effect revealed that number of positive ties was a statistically stronger predictor of leisure activity, compared to diversity of positive ties. These findings indicate that having more positive ties is likely to be associated with greater opportunities for leisure activity, regardless of their diversity. For example, the presence of two positive ties that reflect two role relationships (e.g., spouse/partner and friend) would be no more strongly associated with activity than would the presence of two positive ties that reflect only one relationship role (e.g., friends). These findings have implications for activity-based interventions, implying that strategies aiming to diversify older adults' social roles may be less effective than those aiming to expand their number of positive ties.

Ambivalent ties and leisure activity. Number and diversity of ambivalent ties did not significantly predict leisure activity, together, uniquely, or separately. Some literature suggests that ambivalent ties might promote leisure activity, even if those activities are obligatory (Coleman & Iso-Ahola, 1993); whereas other literature suggests that ambivalent ties might deter activity because older adults would attempt to limit exposure to these ties (Charles, 2010). We found no evidence for either of these postulations, however. It would seem, therefore, that failure

to distinguish methodologically between ambivalent ties and positive ties could obscure their associations with leisure activity – which has previously been noted with regard to health outcomes (Uchino et al., 2004). Perhaps the role of ambivalent ties in leisure activity depends on other factors not measured in our study. For instance, recent literature suggests that ambivalent ties are strongly related to perceptions of guilt (e.g., feeling guilty for not spending enough time with family), particularly in relationships between parents and adult children (Kalmijn, 2020). Future research could examine the role of guilt in links between ambivalent ties and leisure activity.

Limitations and Future Directions

The present study has limitations that should be addressed in future research. First, the cross-sectional nature of the data makes it difficult to rule out reverse causation. It is possible that older adults with poor health may be physically limited in their opportunities for social interactions. Even in the context of poor health, however, research suggests that social ties play an important role as resources in helping older adults participate in leisure activities (Hutchinson & Nimrod, 2012). Additionally, our inclusion of chronic conditions as a covariate helps to rule out the influence of health status. Other empirical work has also provided some evidence against simple reverse causation. Previous longitudinal studies have shown that the association between social network characteristics and mortality do not change over time, despite the fact that older adults' physical functioning tends to decline (Elwardt et al., 2015). Future studies are needed, however, to directly examine this issue of causation.

This study was also limited by a lack of racial and ethnic diversity among our sample of older adults. Our sample is nationally representative and demographically similar to the current 65+ population. This population is rapidly shifting, however, with a growing proportion of older

adults who identify as members of minority groups. Future studies, therefore, should include more diverse samples to examine potential cultural differences in the associations between social relationships, health, and activity. For example, within rural Hispanic communities, elders often live with family in intergenerational homes, with non-blood relatives sometimes being treated as family (Magilvy, Congdon, Martinez, Davis, & Averill, 2000). These cultural experiences might result in unique perceptions of social roles and relationship quality.

Finally, it is worth noting that several different approaches to measuring diversity of social ties have emerged in the literature. Some studies examine a contact-based network, such as assessing the number of role relationships in which a participant has regular (i.e., at least once every two weeks) contact with at least one person (Cohen et al., 1997). Other researchers have used ecological momentary assessment (EMA) methods to examine the diversity of social contacts during the course of participants' daily lives (Fingerman et al., 2019). A daily contact-based approach is a new direction being adopted by some researchers that shines a different light on what may (or may not) constitute a meaningful social tie. In contrast, the present study examined an exchange-based network, which is intended to capture network members with whom that participant has actually engaged in a range of meaningful positive or negative exchanges of support or companionship. Given that the findings of the present study differ from those of some previous studies of network diversity, it is possible that these different operationalizations of diversity may be capturing different facets of the phenomenon. Future research could benefit from including multiple types of diversity measures in order to thoroughly investigate their potentially different associations with health and well-being.

Conclusion

The findings of the current study challenge the prevailing view in the literature that diversity of social ties has unique effects on health and activity, over and above effects of the sheer number of social ties. Findings suggest that, among older adults, the distinction between number and diversity may not matter for physical health, but does matter for leisure activity, with number of positive ties more strongly related to leisure activity than diversity of positive ties. The current study also sought to extend the existing literature by examining both positive and ambivalent ties, revealing that number and diversity exhibit differential associations with health and activity depending on relationship quality. Together, these findings have important implications for future research, suggesting that social network indices should probe for relationships that have co-occurring positive and negative qualities, as well as those that have largely positive qualities. Public health initiatives and interventions would benefit from accounting for these different kinds of social relationships. Moreover, promoting the formation of positive social ties, irrespective of their role relationships, may have value in optimizing strategies for improving health and well-being among older individuals.

References

Adams, K. B., Leibbrandt, S., & Moon, H. (2011). A critical review of the literature on social and leisure activity and wellbeing in later life. *Ageing and Society, 31*(4), 683-712. doi:10.1017/S0144686X10001091

Agahi, N. & Parker, M. G. (2008). Leisure activities and mortality: does gender matter?. *Journal of Aging and Health, 20*(7), 855-871. doi:10.1177/0898264308324631

Avlund, K., Lund, R., Holstein, B. E., & Due, P. (2004). Social relations as determinant of onset of disability in aging. *Archives of Gerontology and Geriatrics, 38*(1), 85-99. doi:10.1016/j.archger.2003.08.003

Berkman, L. F., Glass, T., Brissette, I., & Seeman, T. E. (2000). From social integration to health: Durkheim in the new millennium. *Social Science & Medicine, 51*, 843-857. doi:10.1016/s0277-9536(00)00065-4

Birditt, K. S., Sherman, C. W., Polenick, C. A., Becker, L., Webster, N. J., Ajrouch, K. J., & Antonucci, T. C. (2020). So close and yet so irritating: Negative relations and implications for well-being by age and closeness. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 75*(2), 327-337. doi:10.1093/geronb/gby038

Caldwell, L. L. (2005). Leisure and health: Why is leisure therapeutic? *British Journal of Guidance & Counselling, 33*(1), 7-26. doi:10.1080/03069880412331335939

Chang, P., Wray, L., & Lin, Y. (2014). Social relationships, leisure activity, and health in older adults. *Health Psychology, 33*(6), 516–523. doi:10.1037/hea0000051

Charles, S. T. (2010). Strength and vulnerability integration: A model of emotional well-being across adulthood. *Psychological Bulletin*, 136, 1068-1091. doi:10.1037/a0021232

Charles, S. T., & Carstensen, L. L. (2010). Social and emotional aspects of aging. *Annual Review of Psychology*, 61, 383–409. doi:10.1146/annurev.psych.093008.100448

Cohen, S., Doyle, W. J., Skoner, D. P., Rabin, B. S., & Gwaltney, J. M. (1997). Social ties and susceptibility to the common cold. *Journal of the American Medical Association*, *277*(24), 1940-1944. doi:10.1001/jama.1997.03540480040036

Cohen, S. & Lemay, E. P. (2007). Why would social networks be linked to affect and health practices?. *Health Psychology, 26*(4), 410-417. doi:10.1037/0278-6133.26.4.410

Coleman, D. & Iso-Ahola, S. E. (1993). Leisure and health: The role of social support and self-determination, *Journal of Leisure Research*, *25*(2), 111–128. doi:10.1080/00222216.1993.11969913

Ellwardt, L., van Tilburg, T., Aartsen, M., Wittek, R., & Steverink, N. (2015). Personal networks and mortality risk in older adults: A twenty-year longitudinal study. *PloS one*, *10*(3), e0116731. doi:10.1371/journal.pone.0116731

Fekete, E. M., Stephens, M. A. P., Druley, J. A., & Greene, K. A. (2006). Effects of spousal control and support on older adults' recovery from knee surgery. *Journal of Family Psychology, 20*(2), 302-310. doi:10.1037/0893-3200.20.2.302

Field, D. R. & O'Leary, J. T. (1973). Social groups as a basis for assessing participation in selected water activities. *Journal of Leisure Research*, *5*(2), 16-25. doi:10.1080/00222216.1973.11970124

Fingerman, K. L., Hay, E. L., & Birditt, K. S. (2004). The best of ties, the worst of ties: Close, problematic, and ambivalent social relationships. *Journal of Marriage and Family, 66*, 792-808. doi:10.1111/j.0022-2445.2004.00053.x

Fingerman, K. L., Huo, M., Charles, S. T., & Umberson, D. J. (2019). Variety is the spice of late life: Social integration and daily activity. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences,* 1-12. doi:10.1093/geronb/gbz007

Fiori, K. L., Smith, J., & Antonucci, T. C. (2007). Social network types among older adults: A multidimensional approach. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 62*(6), P322-P330. doi:10.1093/geronb/62.6.P322

Franke, T., Tong, C., Ashe, M. C., McKay, H., Sims-Gould, J., & Team, T. W. T. T. (2013). The secrets of highly active older adults. *Journal of Aging Studies*, *27*(4), 398-409. doi:10.1016/j.jaging.2013.09.003

Friedman, H. S., Tucker, J. S., Schwartz, J. E., Tomlinson-Keasey, C., Martin, L. R., Wingard, D. L., & Criqui, M. H. (1995). Psychosocial and behavioral predictors of longevity: The aging and death of the "Termites". *American Psychologist*, *50*(2), 69-78. doi:10.1037//0003-066x.50.2.69

Glancy, M. & Little, S. L. (1995). Studying the social aspects of leisure: Development of the multiple-method field investigation model (MMFI). *Journal of Leisure Research*, *27*(4), 305-325. doi: 10.1080/00222216.1995.11949752

Greenland, S., Senn, S. J., Rothman, K. J., Carlin, J. B., Poole, C., Goodman, S. N., & Altman, D. G. (2016). Statistical tests, P values, confidence intervals, and power: a guide to misinterpretations. *European Journal of Epidemiology*, *31*(4), 337-350. doi:10.1007/s10654-016-0149-3

Holt-Lunstad, J., Uchino, B. N., Smith, T. W., Olson-Cerny, C., & Nealey-Moore, J. B. (2003). Social relationships and ambulatory blood pressure: Structural and qualitative predictors of

cardiovascular function during everyday social interactions. *Health Psychology, 22*(4), 388–397. doi:10.1037/0278-6133.22.4.388

Holt-Lunstad, J., Smith, T. B., & Layton, J. B. (2010). Social relationships and mortality risk: A meta-analytic review. *PLoS Medicine, 7*(7), e1000316. doi:10.1371/ journal.pmed.1000316

Hutchinson, S. L. & Nimrod, G. (2012). Leisure as a resource for successful aging by older adults with chronic health conditions. *The International Journal of Aging and Human Development, 74*(1), 41-65. doi:10.2190/AG.74.1.c

Kalmijn, M. (2020). Guilt in Adult Mother–Child Relationships: Connections to Intergenerational Ambivalence and Support. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 75*(4), 879-888.

Katz, S., Ford, A. B., Moskowitz, R. W., Jackson, B. A., & Jaffe, M. W. (1963). Studies of illness in the aged. The index of ADL: A standardized measure of biological and psychosocial function. *Journal of the American Medical Association, 185,* 914-919. doi:10.1001/jama.1963.03060120024016

Keller-Cohen, D., Fiori, K., Toler, A., & Bybee, D. (2006). Social relations, language and cognition in the 'oldest old'. *Ageing & Society, 26*(4), 585-605. doi:10.1017/S0144686X06004910

Kelly, J. R. (1996). *Leisure* (3rd ed.). Boston, MA: Allyn & Bacon.

Lampinen, P., Heikkinen, R. L., Kauppinen, M. & Heikkinen, E. (2006). Activity as a predictor of mental well-being among older adults. *Aging and Mental Health, 10*(5) 454–66. doi:10.1080/13607860600640962

Lawton, M. P., & Brody, E. M. (1969). Assessment of older people: Self-maintaining and instrumental activities of daily living. *The Gerontologist, 9,* 179-186.

Lee, C. & Payne, L. L. (2015). Exploring the relationship between different types of serious leisure and successful aging. *Activities, Adaptation, & Aging, 39*, 1-18. doi:10.1080/01924788.2015.994415

Lee, I. A. & Preacher, K. J. (2013, September). Calculation for the test of the difference between two dependent correlations with one variable in common [Computer software]. Available from http://quantpsy.org.

Magilvy, J. K., Congdon, J. G., Martinez, R. J., Davis, R., & Averill, J. (2000). Caring for our own: Health care experiences of rural Hispanic elders. *Journal of Aging Studies*, *14*(2), 171-190. doi:10.1016/S0890-4065(00)80010-9

Mccallister, L., & Fischer, C. S. (1978, 11). A Procedure for Surveying Personal Networks. *Sociological Methods & Research, 7*(2), 131-148. doi:10.1177/004912417800700202

McDonough, M. H. (2013) Sociology of leisure and outdoor recreation: From a small seed. *Society & Natural Resources*, *26*(2), 152-157. doi:10.1080/08941920.2013.739525

Mendes de Leon, C. F., Glass, T. A., & Berkman, L. F. (2003). Social engagement and disability in a community population of older adults: the New Haven EPESE. *American Journal of Epidemiology*, *157*(7), 633-642. doi:10.1093/aje/kwg028

Menec, V. H. (2003). The relations between everyday activities and successful aging: A 6-year longitudinal study. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 58B*(2), S74-S82. doi:10.1093/geronb/58.2.S74

Meng, X., Rosenthal, R., & Rubin, D. B. (1992). Comparing correlated correlation coefficients. *Psychological Bulletin*, *111*, 172–175. doi:10.1037//0033- 2909.111.1.172

Nagi, S. Z. (1976). An epidemiology of disability among adults in the United States. *Milbank Memorial Fund Quarterly, 54*(4), 439–467.

Newsom, J. T., Rook, K. S., Nishishiba, M., Sorkin, D. H., & Mahan, T. L. (2005). Understanding the relative importance of positive and negative social exchanges: Examining specific domains and appraisals. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 60*(6), P304–P312. doi:10.1093/geronb/60.6.p304

Rook, K. S., Luong, G., Sorkin, D. H., Newsom, J. T., & Krause, N. (2012). Ambivalent versus problematic social ties: Implications for psychological health, functional health, and interpersonal coping. *Psychology and Aging, 27*(4), 1–24. doi:10.1037/a0029246.

Rosow, I. & Breslau, N. (1966). A Guttman health scale for the aged. *Journal of Gerontology, 21*(4), 556-559. doi:10.1093/geronj/21.4.556

Rowe, J. W. & Kahn, R. L. (1997). Successful aging. *The Gerontologist, 37*(4), 433-440. doi:10.1093/geront/37.4.433

Sasidharan, V., Payne, L., Orsega-Smith, E., & Godbey, G. (2006). Older adults' physical activity participation and perceptions of wellbeing: Examining the role of social support for leisure. *Managing Leisure*, *11*(3), 164-185. doi:10.1080/13606710600715242

Sorkin, D. H., & Rook, K. S. (2004). Interpersonal control strivings and vulnerability to negative social exchanges in later life. *Psychology and Aging*, *19*(4), 555-564. doi:10.1037/0882-7974.19.4.555

Steiger, J. H. (1980). Tests for comparing elements of a correlation matrix. *Psychological Bulletin, 87*, 245-251. doi:10.1037/0033-2909.87.2.245

Uchino, B. N., Holt-Lunstad, J., Smith, T. W., Bloor, L. (2004). Heterogeneity in social networks: A comparison of different models linking relationships to psychological outcomes. *Journal of Social and Clinical Psychology, 23*(2), 123-139. doi:10.1521/jscp.23.2.123.31014

Uchino, B. N., Cawthon, R. M., Smith, T. W., Light, K.C., McKenzie, J. … Bowen, K. (2012). Social relationships and health: Is feeling positive, negative, or both (ambivalent) about your social ties related to telomeres? *Health Psychology, 31*(6), 789-796. doi:10.1037/a0026836

U.S. Census Bureau (2002). *U.S. Summary: 2000*.

Table 1

Means, Standard Deviations, and Intercorrelations for the Study Variables

	M (*SD*)	1	2	3	4	5	6	7	8	9
Covariates										
1. Age	74.12 (6.64)	--								
2. Sex[a]	--	.05	--							
3. Education[b]	4.56 (1.99)	-.06	-.13***	--						
4. Health Conditions[c]	2.20 (1.55)	.02	-.05	-.14***	--					
Predictors										
5. No. Positive Ties[1]	4.72 (2.76)	-.07*	.01	.04	.004	--				
6. Div. Positive Ties[1]	2.52 (1.20)	-.03	-.002	.04	.04	.71***	--			
7. No. Ambivalent Ties[2]	1.63 (.85)	-.07	-.03	-.08	.13*	--	--	--		
8. Div. Ambivalent Ties[2]	1.35 (.57)	-.08	-.06	.01	-.01	--	--	.77***	--	
Outcomes										
9. Functional Limitations	.62 (.62)	.26***	.13***	-.23***	.38***	-.09**	-.04	.15*	.01	--
10. Leisure Activity	1.95 (.73)	-.15***	.14***	.26***	-.13***	.27***	.196***	-.03	.06	-.34***

Note. Descriptive information and correlations between covariates and outcomes are based on all participants (N = 874); [1]descriptive information and correlations with positive ties variables are based on participants with any positive ties (n = 854); [2]descriptive information and correlations with ambivalent ties variables are based on participants with any ambivalent ties (n = 300).
[a]0 = *male*, and 1 = *female*.
[b]1 = *less than junior high*, 2 = *junior high*, 3 = *some high school*, 4 = *high school*, 5 = *vocational*, 6 = *some college*, 7 = *college degree*, 8 = *some graduate work*, and 9 = *advanced degree*.
[c]Number of chronic health conditions (possible range 0 to 12).
*p < .05. **p < .01. ***p < .001

Table 2

Predicting Functional Limitations and Leisure Activity from Number and Diversity of Positive Ties

	Functional Limitations						*Leisure Activity*					
		95% CI_{boot} for *b*						95% CI_{boot} for *b*				
Variables	*b*	Lower	Upper	*β*	*t*	sr^2	*b*	Lower	Upper	*β*	*t*	sr^2
(Constant)	-1.18	-1.62	-.74	--	-5.52***	--	2.22	1.68	2.76	--	8.33***	--
Block 1												
Age	.02	.02	.03	.24	8.09***	.06	-.01	-.02	-.01	-.13	-4.22***	.02
Sex[a]	.17	.099	.25	.14	4.62***	.02	.25	.16	.34	.17	5.34***	.03
Education[b]	-.04	-.06	-.03	-.15	-4.86***	.02	.09	.07	.11	.26	8.05***	.06
Health Conditions[c]	.15	.13	.18	.38	12.96***	.14	-.04	-.06	-.01	-.08	-2.39*	.005
Block 2												
No. Positive Ties	-.02	-.03	-.001	-.08	-1.90[†]	.003	.06	.04	.09	.25	5.59***	.03
Div. Positive Ties	.003	-.04	.04	.01	.14	<.001	.005	-.04	.06	.01	.19	<.001

Note. The left and right panels show results from separate hierarchical regression analyses predicting functional limitations [overall model: R^2 = .28, Adjusted R^2 = .27, $F(6, 843) = 54.34$, $p < .001$] and leisure activity [overall model: R^2 = .19, Adjusted R^2 = .18, $F(6, 842) = 32.29$, $p < .001$]; *β* standardized regression coefficient; sr^2 squared semi-partial correlation coefficient.

[a]0 = *male*, and 1 = *female*.

[b]1 = *less than junior high*, 2 = *junior high*, 3 = *some high school*, 4 = *high school*, 5 = *vocational*, 6 = *some college*, 7 = *college degree*, 8 = *some graduate work*, and 9 = *advanced degree*.

[c]Number of chronic health conditions (possible range 0 to 12).

[†]$p < .10$. *$p < .05$. **$p < .01$. ***$p < .001$.

Table 3

Predicting Functional Limitations and Leisure Activity from Number and Diversity of Ambivalent Ties

	Functional Limitations						*Leisure Activity*					
		95% CI_{boot} for *b*						95% CI_{boot} for *b*				
Variables	*b*	Lower	Upper	*β*	*t*	sr^2	*b*	Lower	Upper	*β*	*t*	sr^2
(Constant)	-1.36	-2.22	-.51	--	-3.30**		1.92	.87	2.92	--	3.78***	--
Block 1												
Age	.02	.01	.03	.23	4.46***	.05	-.01	-.02	.01	-.05	-.81	0.002
Sex[a]	.08	-.07	.22	.06	1.16	.003	.20	.03	.39	.14	2.37*	0.02
Education[b]	-.02	-.06	.02	-.06	-1.17	.003	.07	.03	.11	.197	3.33**	0.03
Health Conditions[c]	.15	.12	.195	.37	6.95***	.12	-.04	-.095	.01	-.096	-1.63	0.01
Block 2												
No. Ambivalent Ties	.16	.01	.31	.21	2.63**	.02	-.10	-.27	.06	-.12	-1.35	0.01
Div. Ambivalent Ties	-.16	-.37	.06	-.14	-1.76†	.01	.19	-.03	.43	.15	1.73†	0.01

Note. The left and right panels show results from separate hierarchical regression analyses predicting functional limitations [overall model: R^2 = .26, Adjusted R^2 = .24, $F(6, 292) = 17.02$, $p < .001$] and leisure activity [overall model: R^2 = .08, Adj. R^2 = .06, $F(6, 291) = 4.38$, $p < .001$]; *β* standardized regression coefficient; sr^2 squared semi-partial correlation coefficient.

[a]0 = *male*, and 1 = *female*.

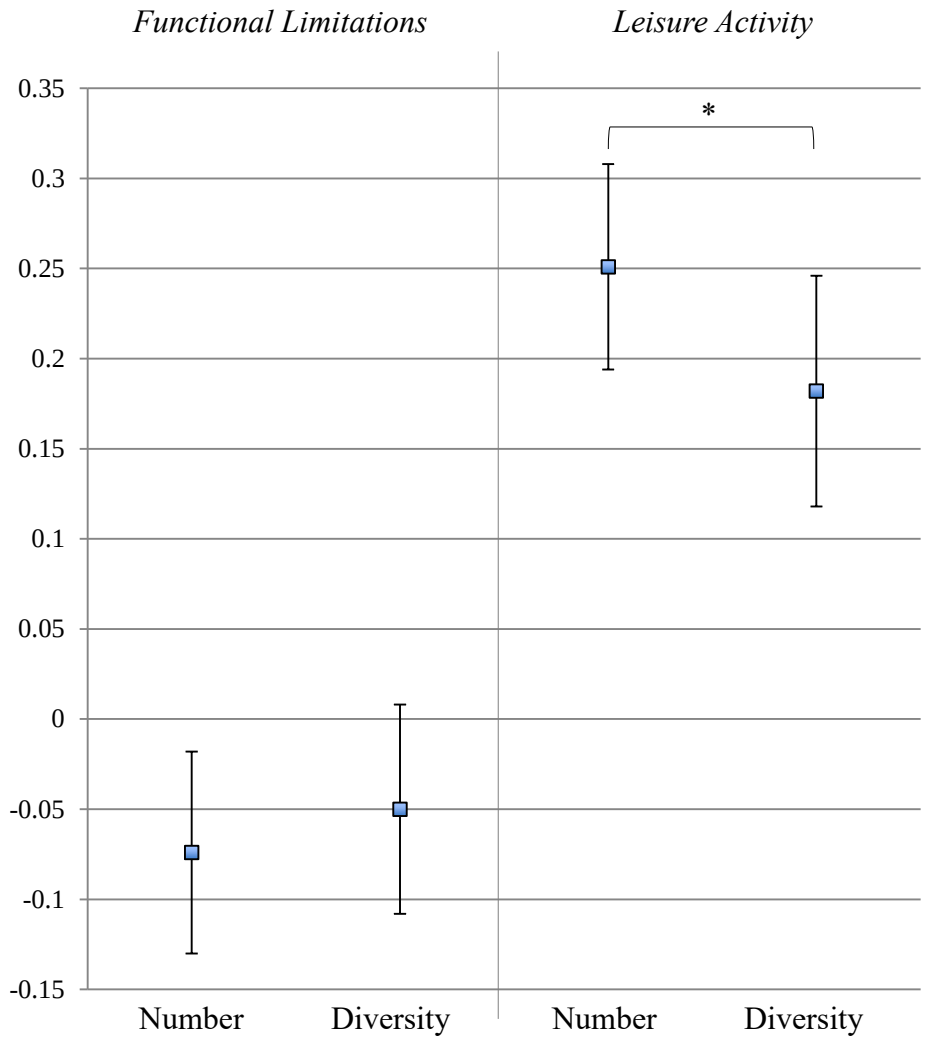
[b]1 = *less than junior high*, 2 = *junior high*, 3 = *some high school*, 4 = *high school*, 5 = *vocational*, 6 = *some college*, 7 = *college degree*, 8 = *some graduate work,* and 9 = *advanced degree.*

[c]Number of chronic health conditions (possible range 0 to 12).

†$p < .10$. *$p < .05$. **$p < .01$. ***$p < .001$.

Figure 1

Comparing Number versus Diversity of Positive Ties

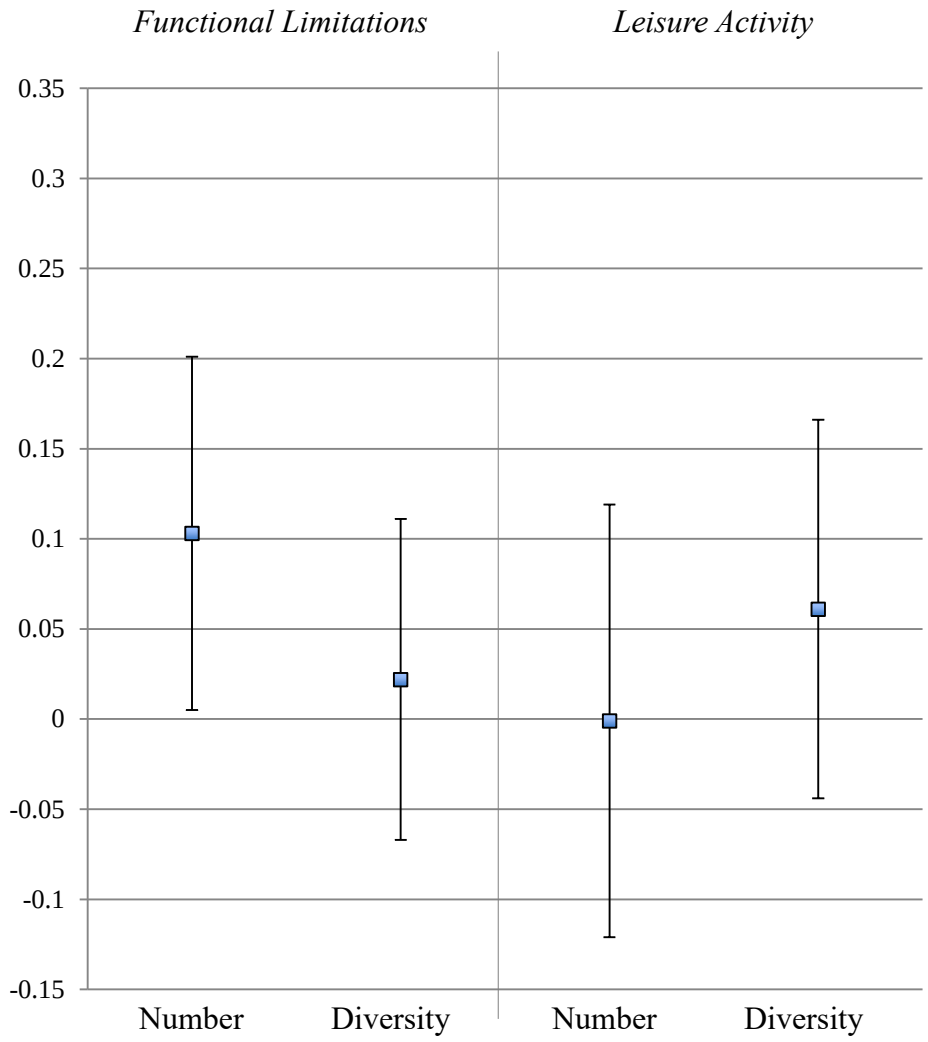


Note. Number and diversity of positive ties were each examined in separate hierarchical regression models predicting functional limitations (left panel) and leisure activity (right panel), adjusting for age, sex, education, and health conditions. Social network predictors and outcome variables were standardized in each model. Each point estimate is a standardized regression coefficient (β) and its confidence interval (95% CI_{boot}). Coefficients are significantly different if their confidence intervals do not contain the coefficient from the other (Greenland et al., 2016).

*$p < .05$.

Figure 2

Comparing Number versus Diversity of Ambivalent Ties



Note. Number and diversity of ambivalent ties were each examined in separate hierarchical regression models predicting functional limitations (left panel) and leisure activity (right panel), adjusting for age, sex, education, and health conditions. Social network predictors and outcome variables were standardized in each model. Each point estimate is a standardized regression coefficient (β) and its confidence interval (95% CI_{boot}). Coefficients do not significantly differ if one of their confidence intervals contains the coefficient from the other (Greenland et al., 2016).