THE DYNAMICS OF SOCIAL NETWORKS AND HEALTH IN AN ASSISTED LIVING FACILITY

BY

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DISSERTATION

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Abstract

Social relationships are critical to the well-being and health of the approximately one million older Americans living in assisted living facilities (ALFs). However, some ALF residents experience loneliness and social isolation. Residents' physical impairments, cognitive functioning, and level of depression may determine their trajectories of disability and influence their ability to form and maintain social ties. In spite of this, little is known about the dynamics of residents' social networks and health. This dissertation examines these dynamics among residents of an ALF in Houston, TX using longitudinal social network analysis. It describes four types of social networks in the facility and provides insights into the structure and dynamics of residents' social ties. In addition, it explores the co-evolution of residents' disability-related health and social relationships. The study found that many residents engaged in social support, there was a robust acquaintance network and that many residents reported companionships with other residents. Negative interactions were reported by the majority of residents. The study did not find support for the hypothesized co-evolution of residents' social networks and disability-related health nor evidence of social selection or influence in disability-related health over the course of three months. On the most fundamental level, this research suggests that ALFs themselves are an effective intervention to support the social integration of older adults who have lost some of their independence. Other practice implications concern residents' emotional needs and negative interactions. Long-term care policies should consider social integration as a potential benefit of ALFs and seek ways to provide equitable access to care in ALFs.

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Chapter 1: Introduction

Problem Statement and Significance

Approximately 70% of Americans over the age of 65 will need some type of long-term personal care and assistance in their lifetime (Hooyman, Mahoney, & Sciegaj, 2016). This need arises from disability, i.e., "difficulty doing tasks/roles on one's own due to health and lasting for some time" (Verbrugge, 2016, pp. 1124-1125). Long-term services and support (LTSS) cost Americans $338.8 billion in 2013 (Colello & Talaga, 2015), not including over $470 billion in unpaid informal care provided by family and friends (Reinhard, Feinberg, Choula, & Houser, 2015). The prevalence and severity of disability increases with age, with the highest rates found in those age 85 and older (Chatterji, Byles, Cutler, Seeman, & Verdes, 2015). There are currently around six million Americans age 85 and older and this number is expected to triple to 18 million by 2050, accounting for 4.5% of the population (Ortman, Velkoff, & Hogan, 2014). As a result, it is predicted that U.S. expenditures for LTSS will rise from 1.3 percent of gross domestic product to as much as 3.3 percent by 2050 (Hagen, 2013).

While many older adults with disability maintain levels of functioning for long periods of time and some even improve, the most common disability trajectories include slow, steady declines or rapid decreases in physical functioning and independence (Verbrugge, 2016). Reduced cognitive functioning, physical impairments, and depressive symptoms are disability-related health factors that are associated with increasing levels of disability (Baernholdt, Hinton, Yan, Rose, & Mattos, 2012; Lenze et al., 2001). Interventions aimed at these factors could potentially mitigate the burgeoning social costs of LTSS (Hagen, 2013).

One model of LTSS care designed to increase independence for disabled older adults is assisted living (Yamasaki & Sharf, 2011; Zimmerman et al., 2003). Assisted living facilities (ALFs) are residential facilities that offer monitoring and assistance with personal care and household maintenance. They serve older adults who cannot live independently, but do not need the intense level of medical care provided at a skilled nursing facility, colloquially known as a "nursing home" (Park-Lee et al., 2011). ALFs generally offer a more homelike setting than skilled nursing facilities (Grabowski, Stevenson, & Cornell, 2012) and may delay or prevent the need for receiving care in a skilled nursing facility (Bowblis, 2014). Americans prefer receiving care in an ALF to a nursing home by a margin of 6.5 to 1 (Kaiser Family Foundation, 2001). Indeed, approximately one million disabled older Americans receive LTSS in assisted living facilities (Harris-Kojetin et al., 2016; Stevenson & Grabowski, 2010) and it is the fastest growing model of institutional care for LTSSs in the United States (Singh, 2016).

The average cost of living and receiving care in an ALF is $3750 per month, substantially less than the $8,121 average for care in a skilled nursing facility (Genworth, 2017). These costs are not covered by Medicare which does not pay for LTSS ("Your Medicare Coverage," n.d.). In contrast, Medicaid does cover the expense of care in a skilled nursing facility, but only pays for assisted living in states with Medicaid waivers for assisted living (Bowblis, 2014). Although 43 states have some type of Medicaid waiver to cover care in assisted living, the coverage is low and does not include room and board (Medicaid's Assisted Living Benefits, 2017). This leaves many people residing in ALFs to pay for the service out of pocket or with coverage from long-term care insurance policies they purchased earlier in life (Genworth, 2015).

An important feature of ALFs is that they are communal environments in which residents dine together, share common spaces, and have opportunities to participate in group activities (Bowblis, 2012; Harris-Kojetin et al., 2016; Jang, Park, Dominguez, & Molinari, 2014). Residents forge relationships with one another (Kemp, Ball, Hollingsworth, & Perkins, 2012; Kemp, Ball, & Perkins, 2016; Sefcik & Abbott, 2014). As such, living in ALFs could enhance residents' social integration (i.e., having positive relationships and social contact). This is promising because social integration is related to lower levels of depression, better physical health, and better cognitive functioning (Barger, 2013; Barnes, Mendes de Leon, Wilson, Bienias, & Evans, 2004; Cornwell & Schafer, 2016; Krause, 2006b; Uchino, Bowen, Carlisle, & Birmingham, 2012). In fact, social relationships are critical for ALF residents' well-being and satisfaction with life (Jang et al., 2014; Street, Burge, Quadagno, & Barrett, 2007). In contrast, socially isolated people face a risk factor for mortality that is as large as smoking, substance abuse, or obesity (Holt-Lunstad, Smith, & Layton, 2010; House, 2001). The field of social work recognizes eradicating social isolation one of the Grand Challenges of Social Work (Lubben, Gironda, Sabbath, Kong, & Johnson, 2015). Because the prevalence of social isolation among older Americans ranges from 10-43% (Nicholson, 2012), efforts to support older adults' social integration are warranted.

Fostering residents' social relationships may be an effective way to support the health of ALF residents and slow their trajectories of disability. However, there are two factors that may undermine residents' social integration. The first is that the act of moving to an ALF constitutes a major life transition that can disrupt existing social networks and result in experiences of social isolation, exclusion, or loneliness (Baur, Abma, Boelsma, & Woelders, 2013; Salari, Brown, & Eaton, 2006). The second is that the levels of impaired functioning and high prevalence of depression among ALF

residents could render them less able to form and maintain the very relationships that could bolster their health (Buckley & McCarthy, 2009; Caffrey et al., 2012; Sandhu, Kemp, Ball, Burgess, & Perkins, 2013).

There is scant literature on residents' social networks in the unique social environment of an ALF and little evidence about how connected residents are with each other. Additionally, little is known about the association between ALF residents' social relationships and trajectories of disability-related health. More knowledge is needed to inform practices to support residents' social integration.

Researchers tend to explore social relationships in one of two main ways. The first is through survey-based research in which a respondent is asked to report on a variety of individual-level attributes such as being married, or living alone, the number of people in a social network (e.g., "how many friends do you have?"), the frequency of contact with others, or satisfaction with relationships. The second takes a broader network approach by eliciting responses from individuals who are in relationship with one another or who belong to a defined social network (e.g., go to the same church). An example of this type of research is a study that examines dyadic coping by asking both partners in a romantic relationship to report on their perceptions of the relationship.

Much of the research on social relationships and health uses the first approach, measuring and analyzing individual-level attributes. More recently, however, researcher have examined dyads—or pairs of individuals—as the unit of measurement in relationship studies. These studies of dyads suggest that health outcomes of one individual can be affected by the characteristics or behaviors of someone else (Gleason, Bolger, Iida, & Shrout, 2008; Thomas, 2010). Relationships beyond a particular dyad (e.g., the friends of an acquaintance) also influence health outcomes (Smith & Christakis, 2008). Some of the latest research on social networks (using *whole* or *sociometric* social

network analysis) examines these "supradyadic" effects (Smith & Christakis, 2008). The whole network approach examines relationships within the boundaries of a pre-defined group such as a senior center, social club, or ALF. Social gerontology has recognized the contribution that whole network analysis can make to understanding how social networks relate to the well-being and health of older adults (Cornwell & Schafer, 2016). Yet to date, whole network social network analyses have been underutilized in the field.

The Current Study

This dissertation seeks to increase knowledge about social networks and disability-related health factors (physical limitations, cognitive functioning, and depressive symptoms) among ALF residents. The rationale behind the research is that understanding these phenomena may inform interventions to improve disability trajectories of ALF residents. The study aims to expand the existing knowledge of how social networks and disability-related health co-evolve by examining the degree to which social integration influences health, and alternately the reverse—how health influences social integration. It employs longitudinal social network analysis of whole networks to examine physical limitations, cognitive functioning, depressive symptoms (i.e., "disability-related health factors") and four types of social ties among residents in an ALF facility over the course of three months.

The study poses the following research questions (RQs):

RQ.1: What is the structure of the social networks (e.g., density, centralization, average degree, number of isolates, reciprocity, transitivity, homophily, stability over time) of residents of an ALF accounting for four types of social relationships—companionships, acquaintances, social support, and negative interactions?

RQ.2: How do ALF residents' disability-related health and social factors relate to changes in network ties in each of the four networks?

RQ.3: How do ALF residents' social factors and initial levels of disability-related health relate to changes in ALF residents' disability-related health?

Chapter 2: Overview of Literature

An individual's social networks and health evolve over the life course. While there is strong empirical support showing an association between the two, there remains much that is not known regarding the reciprocal effects of social networks and health. There is no unifying theory that accounts for the trajectories of social relationships and health among older adults (Wong & Waite, 2016) and much of the related empirical evidence is based on cross-sectional research which cannot distinguish between the effects of health on social networks or social networks on health.

This dissertation focuses on health-related factors associated with disability (i.e., physical limitations, cognitive functioning, and depression) and social networks among assisted living facility (ALF) residents. It hypothesizes that residents' social networks will influence their health and their health will influence their social networks. This chapter provides a theoretical and empirical background for the proposed dissertation research.

First, it describes a theory of aging and the paradigm of social network analysis that guide the dissertation's inquiries. Next, it examines mechanisms that the field of social network analysis has identified as important for the creation and maintenance of social ties. Then it discusses literature specific to the social relationships of older adults in residential communities. Next, it presents empirical evidence linking older adults' social networks to their health. For each of four specific types of social relationships examined in the proposed research, a brief description of its connection to general health outcomes (e.g., mortality) is provided and then more detailed information about its association with the disability-related health factors of interest to this dissertation is presented. Important covariates are also discussed. Finally, the chapter summarizes gaps in the current literature and presents the dissertation's research questions and hypotheses.

Theoretical Framework

The theoretical framework for this dissertation is provided by the social competence/breakdown theory of aging from the field of social gerontology and the research paradigm of social network analysis.

Social competence/breakdown theory of aging.

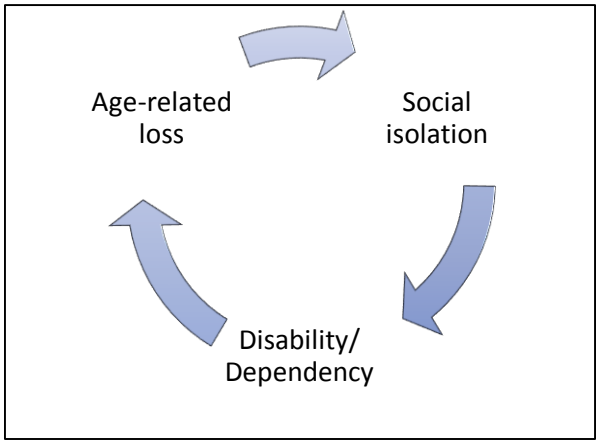
The social competence/breakdown theory of aging describes a reinforcing cycle that leads to disability and dependency in older adults and rests on the premise that mental and physical well-being are "directly related to social-environmental conditions" (Kuypers & Bengtson, 1973, p. 187). The theory is situated in the context of a society that does not value older adults.[1] In this environment, older adults are particularly susceptible to feelings of incompetence and worthlessness when they experience age-related losses such as a health crisis or widowhood.

The social competence/breakdown cycle begins with the vulnerability associated with an age-related loss (Bengtson, 2016) and continues as elements of society label the older adult as incompetent or useless as a result (Bengtson, 2016; Kuypers & Bengtson, 1973). In this step of the cycle, the older adult loses social contacts and social activities (i.e., becomes more socially isolated) which leads to loneliness and depression (Bengtson, 2016). From here, the individual may internalize the labeling of incompetence and assume a role of disability or dependency. In this role, he or she then learns behaviors associated with disability and dependence, thus becoming more entrenched in dependency which leads to further losses. Figure 1 depicts a simplified model of the steps in the cycle of social breakdown. The cycle can also work in the other direction whereby labeling as

[1] Characteristics of a society that doesn't value older adults includes a lack of normative guidelines for older adults that are specific to their age group (as opposed to expecting them to use middle age as their reference group) and a paucity of socially acceptable roles for them to assume (Kuypers & Bengtson, 1973). Almost half a century after this theory was first put forward, these social conditions remain a reality in the United States (Gendron, Welleford, Inker, & White, 2016).

"competent" leads to increased independence and functioning and new or reinforced coping skills. In summary, in conjunction with an individual's sense of competence, social roles and health evolve together and can lead to either an erosion or an enhancement of well-being (Bengtson, 2016; Kuypers & Bengtson, 1973).

Figure 1: Steps in the cycle of social breakdown



From the lens of social competence/breakdown theory of aging, a resident's perceived level of competence, or mastery, could affect his or her social networks and disability-related health. In addition, disability-related health and social relationships would be expected to reinforce one another over time.

Social network analysis.

Social network analysis (SNA) is a research paradigm that offers theories and methods for investigating social relationships (Wasserman & Faust, 2005). SNA sees individuals as interdependent actors embedded in a social structure (i.e., a *network*) that constrain or provide opportunities to its actors. Thus, individuals' states and behaviors depend upon other actors in a given network (Wasserman & Faust, 2005). This is an important foundation of this research—that relationships

exist throughout the ALF and the health status of other residents influence a resident's relationships and disability-related health.

According to theories of social networks, mechanisms that affect individuals and their social ties include the structure of their local networks (i.e., endogenous factors), actor attributes (i.e., exogenous factors), or contextual factors outside the network such as the existence of other relationship types or geography (i.e., exogenous contextual factors) (Lusher & Robins, 2013). In particular, biased net theory states that the networks of people are not random and the patterns of relationships that exist are determined in part by human factors (Rapoport, 1957). Some of the factors acknowledged to bias a network include:

- reciprocity (i.e., the state in which one actor reciprocates a relationship tie from another actor);
- transitivity (i.e., when an actor is tied to two other actors, they tend to also be connected, commonly stated as 'a friend of my friend is also my friend') (Prell, 2012, p. 141);
- shared characteristics, or "homophily";
- shared participation in events; and
- geographical distance, or "propinquity"
  (Feld & Carter, 1998; Lusher & Robins, 2013; McPherson et al., 2001; Rapoport, 1957).

Using the premise of biased net theory, this dissertation hypothesizes that a variety of endogenous and exogenous factors will predict the creation and maintenance of social ties between ALF residents.

Empirical Support

Mechanisms associated with the formation and maintenance of social relationships.

When examining the dynamics of social networks and behavioral outcomes such as disability-related health, it is important to control for endogenous effects that may influence the creation and maintenance of relationships ties (Snijders, Van de Bunt, & Steglich, 2010). Most of the empirical evidence for these endogenous factors comes from studies with children, college students, or in

business settings (Schaefer, Light, Fabes, Hanish, & Martin, 2010), not with older adults (Cornwell & Schafer, 2016). Therefore, this review presents literature from the general SNA literature, rather than from social gerontology.

Definition of terms and basic notation.

Some terminology may help facilitate the discussion of network dynamics. First, the focal individual at any point of consideration is called the *ego*. In a network, the ego is one of a set of actors in the network. When an ego has a relationship with another actor, the other actor is called the ego's *alter*. A tie from ego i to alter j is denoted as $i \rightarrow j$. The existence of a social relationship between an actor and an alter is called a *tie*. Ties can be binary to reflect existence or non-existence of a relationship or valued to reflect qualities of the tie like the strength of the relationship or the frequency of contact. A social network of n actors can represented as an n x n matrix, $\boldsymbol{x}$, where $i \rightarrow j$ is denoted by the value of cell x_{ij} (i.e., x_{ij} is another way of representing $i \rightarrow j$).

Outdegree refers to the number of ties that an ego has reported (i.e., "nominated") in a given network. Outdegree is calculated for actor i as $\sum_{j=1}^{n} x_{ij}$. Outdegree is often considered a measure of ego's involvement in a network (Prell, 2012). *Indegree* refers to the number of nominations that an ego has received from others in the network. *Indegree* is considered a measure of popularity in networks that involve positive relationships such as friendship (Kadushin, 2012). It is calculated for actor i as $\sum_{j=1}^{n} x_{ji}$

The overall structure of a social network can be understood as emerging from local structures within the network such as ties between groups of two or three actors (Pattison & Robins, 2002). Two of these local structures are reciprocity and transitivity (Lusher, Koskinen, & Robins, 2013). Homophily and propinquity are two other local factors that influence social ties (Kadushin, 2012).

Each of these can describe a static characteristic of ties or a dynamic process and are defined and discussed below. Figure 2 presents a visualization of the factors as processes that influence the formation of ties.

Reciprocity.

Reciprocity occurs when an alter reciprocates the nomination of an ego. A reciprocal tie exists when $i \rightarrow j$ and $j \rightarrow i$. Reciprocity is considered a universal and basic characteristic of social networks when relationships are characterized by symmetrical power such as in friendships (Kadushin, 2012). Reciprocity as a dyadic state is observed in static networks; in addition reciprocity is well-established empirically as a social process which drives the formation of network ties. It has been documented in the formation of friendships in a variety of samples including pre-school children (Schaefer et al., 2010), high school students (Fujimoto, Snijders, & Valente, 2017), college students (Igarashi, 2013; Van de Bunt, Van Duijn, & Snijders, 1999; Van Duijn et al., 2003), and naval academy students (de Klepper, Sleebos, Van de Bunt, & Agneessens, 2010). In the context of an ALF, reciprocity might occur when one resident begins to do favors for another resident who previously provided her with support. If reciprocity is a significant predictor of social networks in ALFs, it suggests that having new residents embraced socially by more established residents may be a way to increase their social integration in the ALF.

Transitivity.

Transitivity is a state in which an ego's alters are connected to one another. In network notation, transitivity occurs when if $i \rightarrow j$ and $j \rightarrow k$, then $i \rightarrow k$. This is colloquially stated as "'a friend of my friend is also my friend' (Prell, 2012, p. 141). Transitivity is common in interpersonal relationships (Schaefer et al., 2010; Wasserman & Faust, 2005). Many studies have found it to predict

the formation of relationships in general (de Klepper et al., 2010; Fujimoto et al., 2017; Igarashi, 2013; Kossinets & Watts, 2009; Schaefer et al., 2010), but not all have found it to predict the formation of *friendships*[2] (Van de Bunt et al., 1999; Van Duijn et al., 2003). Schaefer et al. (2010) suggest this is because transitivity is a complex process that, unlike reciprocity, takes more time to unfold for intimate relationships. In an ALF, transitivity could occur if new residents become acquainted with the acquaintances of the members of the Welcoming Committee who greeted them when they moved into the facility.

Homophily.

Homophily is the principle that people who share similar characteristics are more likely to have a relationship with one another than people who are less similar (Lazarsfeld & Merton, 1954; McPherson et al., 2001). Homophily can be based on visible or invisible qualities, ascribed or acquired statuses (e.g., race or education, respectively), or internal states like attitudes and values (Kadushin, 2012; Lazarsfeld & Merton, 1954). Evidence suggests that visible characteristics drive homophily in the early stages of relationship building and invisible characteristics may become important in later stages (Van Duijn et al., 2003). In the United States, homophily based on race/ethnicity is the most prevalent in social networks, followed by "age, religion, education, occupation, and gender…in roughly that order" (McPherson et al., 2001, p. 415). Homophily can also occur when considering shared behaviors, experiences, interests, or personality traits. A common example of homophily regarding shared behaviors is the tendency for adolescents to be friends with peers who have similar smoking or drinking behaviors (Fujimoto, Unger, & Valente, 2012; Fujimoto &

[2] E.g., in Van de Bunt, Van Duijn, & Snijder's (2003) study of college freshmen, transitivity was not a significant process in the formation of *friendships*, but it was in the formation of "friendly relationships" (one step below friendships in their ordinal values for relationships).

Valente, 2013). A more uncommon example comes from a study of the social networks of fourth graders in Germany in which students who owned similar numbers of books at home were more likely to be friends with one another net other factors such as reciprocity, transitivity, gender, religion, and ethnicity (Windzio & Bicer, 2013).

Social selection and social influence are important processes in the formation of homophilous relationships (Lazarsfeld & Merton, 1954). Social selection occurs when individuals detect a similarity and are attracted to one another on the basis of the pre-existing characteristic; social influence occurs when individuals become more similar in the course of a relationship (McPherson et al., 2001). The bulk of the literature on homophilous relationships suggests that social selection is a more influential process than social influence (J. M. Cohen, 1977; de Klepper et al., 2010; McPherson et al., 2001). However, de Klepper, Sleebos, Van de Bunt, and Agneessens (2010) argue that this may be the case only when there are relatively few constraints on relationship choices and when the attributes are visible. To explore this argument, they studied students in a military academy (a high constraint environment) to examine homophily based on attitudes toward military discipline (an invisible characteristic) and found that social influence was more predictive of homophilous relationships than social selection (de Klepper et al., 2010). It is possible that the social environment of ALFs would mirror the conditions that might make social influence a more powerful influence than social selection.

Parsing the impact of social selection from social influence can be an important component of studies that examine social networks and health. Studies have shown that individuals are affected by the health status and behaviors of their companions and friends (Smith & Christakis, 2008; Umberson, Crosnoe, & Reczek, 2010). Indeed, peers can influence each other's health through their

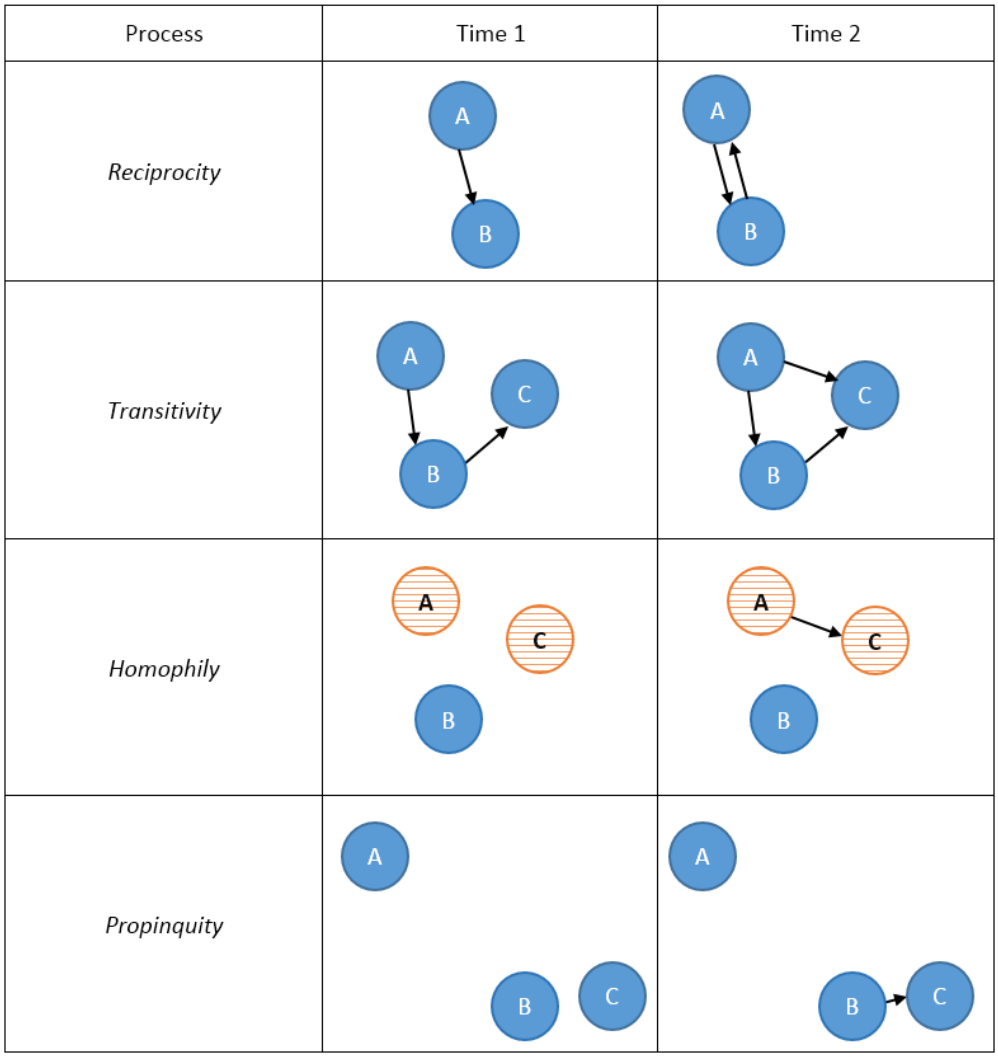
actions and expectations (Berkman, Glass, Brissette, & Seeman, 2000). For some older adults, poor physical health or cognitive functioning can be barriers to forming and maintaining relationships (Nicholson, Dixon, & McCorkle, 2014). In an ALF, it is possible that this would result in residents with similar levels of physical or cognitive functioning forming relationships with one another. Indeed, homophily on health status was found among independent living residents of a continuing care retirement community (Schafer, 2015, 2016). Longitudinal research is needed to discern the relative effects of social influence and social selection on homophily in a given network.

Propinquity.

Propinquity entails "being in the same space at the same time" (Kadushin, 2012, p. 18) and is associated with geographic proximity, mutual attendance at events, enrollment in the same course, or shared foci of activity (Feld, 1981; Kadushin, 2012) such as affiliations with organizations or virtual spaces. It is a well-documented feature of social life (Kadushin, 2012). Propinquity increases the chance that individuals will form a relationship. For example, students in a naval academy who lived on the same corridor were more likely to become friends than those who roomed further apart even after analyses controlled for age, sex, and military specialty (de Klepper et al., 2010). Likewise, the proximity of the homes of fourth graders in Germany predicted the likelihood of two students becoming friends over and above the effects of reciprocity, transitivity, and ethnicity, sex, or religion-based homophily (Windzio & Bicer, 2013). Freshman sociology students who belonged to the same educational cohort (i.e., took all their classes together) were more likely to develop a friendship than students in different cohorts (Van Duijn et al., 2003). In an examination of the email exchanges of 30,396 students, faculty, and staff of a large university in the course of an academic year, Kossinets and Watts (2009) found that individuals who took classes together or belonged to the same

organization's email list were more likely to form relationships than those who did not have this type of propinquity. In their analyses, sharing classes or organizational membership were more influential in predicting relationships than various types of homophily including gender, age, status as faculty, staff, or student, department, and number of years at the university.

Figure 2: Factors related to social network formation



In an ALF, propinquity could be a significant factor if residents who live on the same corridor or who attend the same events are more likely to form relationships. This knowledge could inform

facility design or prompt ALF employees to pay special attention to the social integration of those who live on the ends of corridors rather than the middle. In addition, findings of propinquity could highlight the importance of attendance at group events for residents' social integration.

Factors associated with older adults forming and maintaining social ties.

Empirical evidence regarding the development of older adults' social ties is sparse (Cornwell & Schafer, 2016). In particular, there is little literature about the creation and maintenance of social ties in residential settings such as ALFs, nursing homes, and retirement communities. Abbott, Bettger, Hampton, and Kohler (2012, 2015) conducted a pilot study using social network analysis in a residential LTSS facility's assisted living and dementia care sections. They did not report factors associated with residents' social integration, but presented visualization of the networks of 12 assisted living residents (Abbott, Bettger, Hampton, & Kohler, 2012) and 10 residents in dementia care (Abbott, Bettger, Hampton, & Kohler, 2015) that suggest residents were connected through spending time together or provisions of support. The following two subsections present evidence about factors associated with older adults' social integration in residential communities. They include research from a cross-sectional whole network SNA that was conducted in a retirement community and from studies of social integration in ALFs.

Cross-sectional SNA.

Schafer (2011, 2015, 2016) examined networks of confidants and residents who spent time together in a cross-sectional SNA of relationships and health among 123 independent living residents (*M* = 86.0 years old, *SD* = 4.4 years). The data from this study are unique in that they were collected in one of the few whole network SNAs of older adults. Analyses examined endogenous and exogenous factors associated with the likelihood of confidant and weak ties among older adults in the

community (Schafer, 2015, 2016). The analyses found evidence for reciprocity, transitivity, and homophily in the residents' networks. In the confidant network, residents were more likely to name other residents as confidants if they were the same gender as the respondent, were closer in age to the respondent, and had moved to the retirement community closer to the same time as the respondent (Schafer, 2015). In addition, living on the same hallway increased the odds of confidant ties existing between two residents and residents with more frequent contact with individuals outside the facility were more likely to be named as confidants than those who had less frequent external social contact. The analysis found gender differences in tie formation; women reported fewer confidants and were less likely to be nominated as confidants compared to men (Schafer, 2015). In the network of weak ties—operationalized as spending at least 30 minutes socializing or interacting per week—relationships exhibited homophily by health status, but only among residents in either the lowest or the highest quartile of health status (Schafer, 2016).

Assisted living facilities.

There are a few studies that examine factors related to social integration in ALFs. A qualitative examination of 13 ALF residents found that that their friendships were fostered by making connections soon after moving into the ALF and having something in common, but not through participation in group activities (Sefcik & Abbott, 2014). In a yearlong ethnographic study of two ALFs, researchers determined that homophily based upon age, race, backgrounds such as profession or social class, common interests, and cognitive impairment influenced the creation and maintenance of social ties among residents (Kemp et al., 2012; Sandhu et al., 2013). Having apartments near one another also facilitated friendships. New residents were less likely to participate in activities and

develop friends. Data from in-depth interviews with 29 residents of four ALFs suggest that exchanging support was associated with developing friendships (Park et al., 2012).

In sum, these studies offer evidence that, in certain cases, factors that have been found to predict ties in the networks of younger adults and adolescents are also present in the networks of older adults. More research can increase understanding of the factors that influence the formation and maintenance of social ties in later life. Additional studies are needed to determine if the findings from the retirement community SNA can be replicated, especially in other long-term care settings. Longitudinal studies are needed to understand network dynamics such as the relative impact of reciprocity and transitivity on tie formation or the effects of social influence and social selection on homophily in ALFs.

Social Relationships and Health

Most if not all of the research on the relation between older adults' social networks and health has been conducted among community dwelling older adults with little conducted in long-term care settings such as assisted living facilities. Through it, the predictive value of the social competence/breakdown theory of aging has been partially borne out with empirical research. There is a large body of evidence from cross-sectional research linking social integration to the physical and mental well-being of older adults (House, Landis, & Umberson, 1988; Qualls, 2014). However, the theory goes beyond predicting an association and states there is a bi-directional, causal relationship between social integration and disability-related health factors. Though the evidence is not as large for this longitudinal proposition, a few studies support it.

For example, individuals with higher levels of social integration have been found to have higher levels of subsequent physical and cognitive functioning (Haslam, Cruwys, & Haslam, 2014;

Shankar, McMunn, Demakakos, Hamer, & Steptoe, 2017) and self-rated health (Cornwell, Laumann, & Schumm, 2008). The evidence supporting the reciprocal premise—that older adults' health affects their subsequent social integration—is more limited. This review found only one published article providing empirical support for this direction of influence. In it, lower levels of self-rated health and the existence of depressive symptoms among 2,057 community-dwelling older adults ($M_{baseline}$ = 73.5 years old, *SD* = 6.4 years) predicted significant reductions in their social integration over the course of 12 years (Nicholson, Dixon, & McCorkle, 2014).

Four specific types of relationships are believed to affect the health and well-being of older adults. These four relationship types are (1) companionships, (2) weak ties, (3) enacted social support, and (4) negative interactions (Krause, 2006b). Borgatti, Everett, and Johnson (2013) present a taxonomy of types of social relationships with two basic types of ties: relational *states* and relational *events* (i.e., interactions and flows). Using this taxonomy to categorize these four types of relationships, companionships and weak ties fit into the category of relational states and enacted support and negative interactions are in the category of relational events. There are, however, gaps in our understanding of how each of the four types of relationships co-evolve with disability-related health in older adults.

Companionships.

Companionships include relationships such as spouses and close friends (Krause, 2006b) and may be particularly beneficial to older adults' well-being (S. Cohen & Janicki-Deverts, 2009; Ellwardt, Van Tilburg, & Aartsen, 2015; Fiori, Antonucci, & Cortina, 2006; Litwin & Shiovitz-Ezra, 2011). Among 1,244 community dwelling Spanish adults age 70 to 74, friendships were the only relationship type associated with significantly reduced odds of disability, including both activities of daily living (ADL)

and instrumental activities of daily living (IADL) limitation[3] (Escobar-Bravo, Puga-González, & Martín-Baranera, 2012). Similarly, social networks with greater numbers of close friends were found to be associated with higher levels of cognitive functioning at five waves of data collection over 15 years in a sample of 706 Australians age 70 and older (*M* = 78.6, *SD* = 5.7) (Giles, Anstey, Walker, & Luszcz, 2012). Better cognitive functioning was not associated with other types of relationships such as children or family members.

A few studies have examined companionships and depressive symptoms. A study of 79 community dwelling adults age 60 to 87 (*M* = 69.1, *SD* = 7.88) that controlled for age and education found that having fewer close companions was correlated with higher levels of depressive symptoms (Shouse, Rowe, & Mast, 2013). In the Netherlands, a study of 510 adults age 60 and older found that not having a partner or having five or fewer "meaningful" friends and relatives was associated with elevated levels of depressive symptoms compared to those who had larger networks of friends (Peerenboom, Collard, Naarding, & Comijs, 2015). Similarly, among 707 participants in the Wisconsin Longitudinal Survey (*M* = 64.3 years old, *SD* = 0.70 years), having a close friend as a confidant (as opposed to having a family member as a confidant) buffered the effects of becoming widowed on depressive symptoms and self-rated health (Bookwala, Marshall, & Manning, 2014).

In the whole network study conducted in a continuing care retirement community mentioned above, participants reported which other residents they "talked to about important matters" (Schafer, 2011, p. 4) and completed a self-report assessment of their physical and psychological health. Residents with higher levels of self-reported health were named more often as confidants (i.e., were

[3] ADLs include tasks such as bathing, dressing, getting in and out of bed, and using the toilet. Examples of IADLs are meal preparation, shopping, and managing finances. The ability to perform both ADLs and IADLs is critical for independent living.

more popular) than those with worse self-reported health. This points to the possibility that older adults' health status may affect whether or not their peers form close relationships with them. Interestingly, those in better health named significantly fewer confidants than those in worse health. Because external relationships were not a part of this study, it is possible that this finding was based upon healthier individuals having more confidants outside the retirement community than within it.

In summary, there is evidence of a positive association between companionships and disability-related health factors. However, most of the evidence is from cross-sectional studies, which precludes making inferences about the direction of the association. There is evidence from one longitudinal study that supports that companionships lead to better health (Escobar-Bravo et al., 2012), but this review found no large-scale longitudinal research that investigated the effects of health on companionships. More research is needed to increase our understanding of the co-evolution of companionships and older adults' health.

Weak ties.

Weak ties consist of individuals people know superficially (e.g., acquaintances) (Krause, 2006b, Fingerman, 2009). They are important because they are a valuable source of informational support for older adults (Krause, 2006b) and can develop into companionships (Van Duijn, Zeggelink, Huisman, Stokman, & Wasseur, 2003). However, weak ties are not often examined in relationship research (Fingerman, 2009). As a result, literature on weak ties and disability-related health factors is scarce.

Greenfield and Reyes (2015) examined weak ties in an analysis of data from 1,071 adults age 40 to 70 in the National Survey of Midlife Development in the United States. They found that having low contact with neighbors was related to lower levels of eudaimonic well-being—a construct including competence, sense of purpose, and feelings of personal growth. Losing contact with

neighbors over the course of ten years was also associated with lower well-being. Shouse, Rowe, and Mast (2013) found that respondents' cognitive functioning and number of weak ties were positively correlated among 79 community dwelling adults age 60 to 87 (*M* = 69.1, *SD* = 7.88). In contrast, in a sample of 689 adults age 50 to 95, greater numbers of weak ties were related to lower levels of psychological well-being after controlling for age, sex, race, marital status, education, and health limitations (Thomas, 2010).

In the retirement community SNA, weak ties were also examined (Schafer, 2011, 2016). Residents identified other residents with whom they had socialized or interacted for at least 30 minutes per week (i.e., spent time with). As might be expected, participants reported larger networks of weak ties, *M* = 20.1 alters; *SD* = 16.3, (Schafer, 2011) than confidant networks, *M* = 2.2 alters, *SD* = 2.2 (Schafer, 2015). Similar to the confidant network, in the weak ties network, residents with better self-reported health were significantly more popular and more active (i.e., more likely to report outgoing social ties) than their less healthy counterparts (Schafer, 2011, 2016). However, the cross-sectional design of this study precludes determining directionality (i.e., if popularity and activity promotes good health or good health leads to popularity and activity).

Although studies link weak ties to older adults' well-being, the relative paucity of literature on the topic limits generalizability. In addition, results linking weak ties and well-being are inconsistent. More research is needed to understand the value of weak ties in older adults' social networks, just as it is for all adults in general (Fingerman, 2009).

Enacted social support.

Enacted social support is a relational event (Borgatti et al., 2013); that is, a tie that exists when support is given or received. There are three types of enacted social support. *Emotional* support

entails the exchange of aid in the form of comfort and listening, *instrumental* support entails favors or tangible gifts, and *informational* support is the flow of advice or information (Barrera, Sandler, & Ramsay, 1981; House et al., 1988). Enacted social support can co-exist with a variety of different relational states such as companionships or weak ties.

The literature on *receiving* support contains inconsistent results. However, *giving* social support is generally found to be beneficial (Thomas, 2010). Similar to the literature on companionships and weak ties, a lack of longitudinal research examining reciprocal effects leads to a gap in our understanding of enacted social support and health.

Receiving enacted social support and physical limitations.

In studies linking receiving support to physical and cognitive functioning, both positive and negative outcomes have been found. A longitudinal study using data from a subsample of the MacArthur Studies of Successful Aging (*N* = 1,015 adults age 70 to 79 at baseline) found that receiving emotional support more frequently was associated with improved levels of physical functioning as measured by five tests of physical ability 2.5 years later (Seeman et al., 1995). A different analysis from the same parent study found a gender effect for receipt of support. In a subsample of 1,031 participants, greater frequency of emotional and instrumental support predicted onset of ADL disability[4] in men, but not women, 2.5 years later (Seeman, Bruce, & McAvay, 1996). An analysis of data from 2,812 participants age 65 to 99 in the New Haven Established Populations for the Epidemiologic Studies of the Elderly found that receiving instrumental support from two or more people increased the odds of becoming physically disabled over an eight-year period of time

[4] Because limitations in physical ability are considered to be a precursor to disability (Verbrugge & Jette, 1994), the outcomes examined in these two studies are related but not equivalent.

compared to older adults who received instrumental support from fewer than two people (Mendes de Leon et al., 1999). Receiving emotional support, however, was not associated with the odds of becoming disabled. The analyses in these longitudinal studies examined the effects of enacted support on health-related outcomes; none explored whether health status influenced subsequent levels of enacted support.

Receiving enacted social support and cognitive functioning.

Regarding cognitive functioning, there is evidence to suggest that receiving emotional support is beneficial, but less evidence exists for the salubrious effects of receiving other types of support. Again using data from the MacArthur Studies of Successful Aging, Seeman, Lusignolo, Albert, and Berkman (2001) examined the effects of receiving emotional support on changes in cognitive functioning over 7.5 years in 1,189 older adults who were high-functioning at baseline. They found the protective effects of receiving emotional support were of similar magnitude to well-established factors such as age and education. Analysis on a subsample of participants (n = 2,255) in the Longitudinal Aging Study Amsterdam who were 65 or older at baseline showed that higher levels of enacted emotional support were associated with higher levels of cognitive functioning ($\beta_{\text{intercept}}$ = 0.13, $p < .05$) and increases in enacted emotional support were strongly associated with increases in cognitive functioning (β_{slope} = .42, $p < .001$) over three waves of data collection in six years (Ellwardt, Aartsen, Deeg, & Steverink, 2013). However, in the same subsample, receiving instrumental support was not significantly related to levels of cognitive functioning. Ayotte, Allaire, and Whitfield (2013) examined the association between receiving a composite of emotional, instrumental, and informational support on various domains of cognitive functioning among 602 African American adults (M = 69.1 years old, SD = 9.74 years, 75% female). The frequency with which this composite

social support was received had a significant negative relationship with the cognitive domains of fluid ability and crystallized verbal ability. As in the studies that examined enacted support and physical functioning, these studies did not examine whether levels of cognitive functioning predicted subsequent receipt of enacted support.

Receiving enacted social support and depressive symptoms.

The relation between enacted social support and depressive symptoms has been studied for decades, yet there remains a lack of clarity on the direction of the association. A study of 351 older Texans (*M* = 73.4 years old, *SD* = 6.2 years) found that enacted social support (emotional, instrumental, and informational) buffered the negative effects of bereavement stress on depressive symptoms (Krause, 1986). In a more recent study of 1,359 adults age 70 to 103 in Australia, Chan, Anstey, Windsor and Luszcz (2011) found that receiving instrumental support was associated with reduced depression in people with high levels of disability. In contrast, cross-sectional research with a sample of 388 Floridians age 65 and older found that more types of instrumental and informational support received in the past month were associated with higher levels of depression (Lee, Netzer, & Coward, 1995). Likewise, a study of older adults with vision impairment found a positive association between the number of people from whom participants received instrumental aid in the past month and their current levels of depressive symptoms (Reinhardt, Boerner, & Horowitz, 2006). In addition, another study of 1,103 retirees who were at least 65 years old found that greater frequency of receiving all three types of enacted support in the past year from friends, neighbors, and relatives was associated with higher levels of depressive symptoms in the previous week, even after controlling for health and negative social interactions (Liang, Krause, & Bennett, 2001).

Giving enacted social support.

Although the evidence on the effects of receiving social support remains mixed, most studies that examine *giving* social support find it to be beneficial to older adults (Thomas, 2010). Giving instrumental support was found to significantly reduce the age-adjusted risk of mortality by 40% in a sample of 423 married couples in which the husband was at least 65 years old at baseline (S. L. Brown, Nesse, Vinokur, & Smith, 2003). The reduction in risk of mortality was found over a period of five years controlling for self-rated health, depression, socioeconomic status, and the health-related behaviors of smoking, drinking, and exercising. Krause (2006a) explored 3-year all-cause mortality rates among a national sample of 1,024 older adults ($M_{baseline}$ = 74.2 years old, *SD* = 6.2). Providing emotional support to members of their church reduced the effect of financial strain on mortality. At slightly greater than average levels of giving emotional support, the deleterious effects of financial strain on mortality were completely offset. In Ayotte, Allaire, and Whitfield's (2013) study of older African American adults, the frequency with which participants provided social support was positively associated with levels of cognitive functioning. Thomas (2010) analyzed data from 689 participants age 50 to 95 in the Social Networks in Adult Life survey and found that the greater the amount of support given, the better the participant's psychological well-being. In fact, total support given had the greatest effect (β = 0.28, $p < .001$) of all factors associated with well-being including age, education, income, negative interactions (as measured by number of people who 'get on your nerves'), and support received.

With the exception of the mortality studies cited above, the research on giving enacted support and health outcomes is cross-sectional. As with other relationship types, longitudinal research is needed to better understand the reciprocal dynamics of giving enacted support and

health outcomes. It is intuitive that better health would lead to higher levels of giving support, but it appears this has not been examined in the literature.

Negative interactions.

Negative interactions—defined as rejection, unsupportiveness, disagreements, controlling or invasive behavior—are relational events known to have a deleterious effect on the health of those who experience them (Rook, 2015; Sneed & Cohen, 2014). Negative interactions are uncommon in the social lives of older adults (Rook, 2015); however, when they do exist, their effect may be more harmful than positive interactions' effects are salubrious (Newsom, Rook, Nishishiba, Sorkin, & Mahan, 2005; Rook, 2015; Schuster, Kessler, & Aseltine, 1990).

Krause and Shaw (2002) examined negative interactions and trajectories of disability among a subsample of 507 participants from a nationally representative study of retirees who were 65 or older at baseline. They found that higher levels of negative interaction predicted increases in ADL and IADL limitations over the course of four years for individuals with lower levels of education. A separate analysis of data from 666 participants of the same parent study found that consistently high levels of negative interactions were related to increasing levels of ADL/IADL disability over the course of two years and decreasing levels of global self-rated health (Newsom, Mahan, Rook, & Krause, 2008). In another secondary analyses of these data, Newsom et al. (2005) found that higher levels of negative interaction also predicted increased levels of depressive symptoms. These longitudinal studies find that negative interactions lead to poor health outcomes, but they do not explore whether poor health leads to more negative interactions in the lives of older adults. Indeed, the comprehensive literature search for this dissertation found no studies that examined this question.

Social relationships and health among ALF residents.

Qualitative studies indicate that ALF residents have companionships, weak ties, support, and negative interactions with other residents (Kemp et al., 2012; Kemp et al., 2016; Sefcik & Abbott, 2014). A small body of literature addresses social relationships and health among ALF residents and indicates that levels of functioning may be associated with residents' social relationships. Sefcik and Abbott (2014) conducted focus groups with 13 ALF residents to investigate residents' friendships. They found that limited functional status was both a facilitator and barrier to development of relationships. On one hand, residents with physical limitations received help from other residents and this formed the basis for a relationship. On the other hand, physical limitations and cognitive impairment made it difficult to maintain relationships (Kemp et al., 2012; Sandhu et al., 2013). Residents reported that cognitive functioning was related to negative interactions; residents with cognitive impairment violated social norms and sometimes cognitively intact residents were annoyed with or ostracized residents with cognitive impairment (Sandhu et al., 2013). Similarly, data from in-depth interviews with 29 residents of four ALFs showed that residents avoided residents with cognitive impairment (Park, Zimmerman, Kinslow, Shin, & Roff, 2012). In addition to these qualitative studies, a quantitative study examined correlates of social integration in ALFs and found higher levels of physical functioning were associated with increased social integration among 429 ALF residents from 123 different facilities, (Burge & Street, 2010).

These studies provide some knowledge about the association of social relationships and functioning in ALFs. However, they are limited in number and all are cross-sectional. Additional research is needed to more fully understand the phenomenon of relationships and health co-evolving in the unique environment of an ALF.

Covariates to Consider

The following section presents literature on a variety factors associated with older adults' health or relationships. The material is presented not to reveal gaps in the literature but to demonstrate potential covariates to consider when examining the disability-related health factors of interest in this dissertation research.

Demographic characteristics.

In the United States, individuals who are non-Hispanic White and/or of higher socioeconomic status tend to be privileged in terms of general health (Phelan, Link, & Tehranifar, 2010; Solé-Auró, Beltrán-Sánchez, & Crimmins, 2015) and social network size (Ajrouch, Antonucci, & Janevic, 2001; Ajrouch, Blandon, & Antonucci, 2005; Cornwell et al., 2008). This is also the case for disability and dementia (Germain, Vasquez, Batsis, & McQuoid, 2016; Mayeux & Stern, 2012; Mehta, Sudharsanan, & Elo, 2014). Higher levels of education are protective against depression for older adults (Fiske, Wetherell, & Gatz, 2009), however the literature is inconclusive regarding whether there is a lower prevalence of depression among older non-Hispanic White adults compared to minority groups (Pickett, Bazelais, & Bruce, 2013).

For adults over age 65, increased age is associated with higher prevalence of physical limitations, depression, and dementia (Mayeux & Stern, 2012; Germain et al., 2016; Weyerer et al., 2013) and smaller social networks (Wrzus, Hänel, Wagner, & Neyer, 2013). Compared to older men, older women have a greater likelihood of having physical limitations, being depressed, or having dementia (Barry, Allore, Guo, Bruce, & Gill, 2008; Carter, Resnick, Mallampalli, & Kalbarczyk, 2012; Fiske et al., 2009; Germain et al., 2016), yet they tend to have larger social networks (Cornwell et al., 2008).

Competence/mastery.

Competence is important to consider in this research because of its role in the social competence/breakdown theory of aging (Kuypers & Bengtson, 1973). Competence is not a construct that is measured in the literature, but it is implicit in a variety of terms related to a person's control over events (Skinner, 1996), such as mastery, perceived control, and self-efficacy. *Mastery* is measured by "the extent to which one regards one's life-chances as being under one's control in contrast to being fatalistically ruled" (Pearlin & Schooler, 1978, p. 5). *Perceived control* consists of two factors—mastery and constraints—where constraints are perceived external barriers to achieving desired outcomes (Infurna & Mayer, 2015). *Self-efficacy* describes an individual's belief that he or she can successfully perform behaviors needed to achieve a desired outcome (Sherer et al., 1982).

Levels of competence are related to subsequent health outcomes for older adults. For example, mastery and perceived control are associated with reduced risk of mortality (Fauth, Zarit, Malmberg, & Johansson, 2007; Infurna, Gerstorf, Ram, Schupp, & Wagner, 2011). Higher levels of mastery and perceived control have been found to be associated with lower levels of subsequent physical limitations (Drewelies, Wagner, Tesch-Römer, Heckhausen, & Gerstorf, 2017; Kempen, Ranchor, van Sonderen, van Jaarsveld, & Sanderman, 2006). There is evidence that mastery and perceived control shield against declines in cognitive functioning for older adults (Agrigoroaei & Lachman, 2011; Caplan & Schooler, 2003; Infurna & Gerstorf, 2013). There is a small amount of evidence that certain types of health problems may also influence future levels of competence. The number of health conditions an older adult had did not affect levels of perceived control in one study (Infurna, Gerstorf, & Zarit, 2011), but physical limitations and depressive symptoms were found to

erode mastery in other studies (Assari & Lankarani, 2017; Jang, Chiriboga, Lee, & Cho, 2009; McAvay, Seeman, & Rodin, 1996).

Loneliness.

The social competence/breakdown theory of aging predicts that older adults in the cycle of breakdown will experience loneliness (Bengtson, 2016). Loneliness is a subjective perception that arises when an individual is not satisfied with his or her objective levels of social integration (Peplau & Perlman, 1982). There is a distinction between feeling lonely and the objective state of having a limited social network. Intuitively we understand that a person with many friends can be lonely or someone with no friends may not feel lonely at all. In fact, measures of older adults' subjective loneliness are only weakly to moderately correlated with objective measures of social integration such as size of social networks, frequency of contact with friends and family, and participation in group activities (Coyle & Dugan, 2012; Shankar et al., 2017; Shiovitz-Ezra & Leitsch, 2010; York Cornwell & Waite, 2009). There is evidence that the effects of loneliness on health are distinct from those of social isolation, leading to calls for social gerontologists to examine both loneliness and objective measures of social integration when studying social relationships and health (Shankar et al., 2017; York Cornwell & Waite, 2009).

Levels of loneliness significantly increase mortality risk in older adults, OR = 1.26, 95% CI = [1.04, 1.53] (see meta-analysis of 13 studies by Holt-Lunstad, Smith, & Layton, 2015). In addition, longitudinal studies have found that higher levels of loneliness predict higher levels of physical limitations (Shankar et al., 2017), lower levels of cognitive functioning (Shankar, Hamer, McMunn, & Steptoe, 2013; Tilvis, Jolkkonen, & Strandberg, 2000; R. S. Wilson et al., 2007), and elevated

depressive symptoms (Cacioppo, Hughes, Waite, Hawkley, & Thisted, 2006; Heikkinen & Kauppinen, 2004).

Gaps in the Literature

As outlined above, there is a robust literature linking older adults' social relationships and health. Nonetheless, we have limited knowledge in the following areas. First, much of the literature reports on cross-sectional research. In these types of analyses, it cannot be determined if relationships influence health, if health influences relationships, or both. Analyses of longitudinal studies using dynamic models would allow scientists to address this question, but these types of studies are rare in the literature (some notable exceptions include Infurna et al., 2011 and Cacioppo et al., 2006). Most of the extant longitudinal research focuses on the influence of social integration on health, but does not investigate how health status influences social networks. Second, the inconsistent results regarding the receipt of enacted social support have not been fully explained. This gap is not the main focus of this dissertation research, but data collected in this project will allow for analyses concentrating on dyadic or supradyadic factors that moderate the effect of receiving support on health outcomes. Third, there are relatively few studies examining the effects of weak ties and negative interactions, especially compared to those that examine companionships and social support. However, these types of relationships are important to the health of older adults. Fourth, almost all of our knowledge of older adults' social relationships and health comes from studies with community dwelling individuals. We do not know if the unique aspects of living in a facility make the interplay of health and relationships different for residents than for people who live in their own home. Lastly, most of the research on social relationships has used a traditional survey approach that uses individual-level measures only and does not consider dyadic or supradyadic factors. However, it

seems likely that these factors have important effects on older adults' health and they should be more thoroughly examined.

This literature review uncovered no longitudinal studies using a whole network design. Without longitudinal whole network designs, we have limited knowledge of the causes and effects of older adults' dyadic and supradyadic ties in a network. In addition, we are left to extrapolate how older adults' social networks are structured from studies of children and younger adults.

Research Questions and Hypotheses

This dissertation aims to address some of these gaps in the literature by examining the social networks and health of residents in a large ALF at two points in time three months apart (wave 1 and wave 2). It assesses four types of social relationships (companionships, acquaintances, enacted social support, and negative interactions) affected by three disability-related health outcomes (physical limitations, cognitive functioning, and depressive symptoms). The hypotheses for endogenous structural effects on network ties are based on the basic network effects recommended to assess the maintenance and creation of network ties (Ripley, Snijders, Boda, Voros, & Preciado, 2017).

RQ.1: What is the structure of the social networks (e.g., density, centralization, average degree, number of isolates, reciprocity, transitivity, homophily, stability over time) of residents of an ALF accounting for four types of social relationships—companionships, acquaintances, social support, and negative interactions?

H.1: No hypotheses are advanced regarding network structure and change as this question is descriptive.

RQ.2: How do ALF residents' disability-related health and social factors relate to changes in network ties in each of the four networks?

H.2(a): Endogenous structural factors related to the creation or maintenance of network ties in each of the four networks from wave 1 to wave 2 include reciprocity, transitivity, a tendency for variation in residents' degree of activity in the network (i.e., outdegree activity), a tendency for variation in residents' degree of popularity (i.e., indegree popularity), and a tendency for residents who are active in the network to also be more popular (i.e., outdegree popularity).

H.2(b): A resident's disability-related health (i.e., physical limitations, cognitive functioning, or depressive symptoms) at wave 1 and wave 2 will relate to the likelihood of the maintenance or creation of outgoing network ties (i.e., ego effects) and incoming network ties (i.e., alter effects). In addition, network ties at wave 2 will be more likely between residents who have similar levels of disability-related health (i.e., similarity effect, which indicates a social selection process).

H.2(c): A resident's level of mastery at wave 1 will relate to the likelihood of creating or maintaining network ties.

H.2(d): Covariates at wave 1 that relate to the maintenance or creation of network ties include age, gender, education, loneliness, participation in group activities, and propinquity (i.e., ego and alter living on the same floor).

RQ.3: How do ALF residents' social factors and initial levels of disability-related health relate to changes in ALF residents' disability-related health?

H.3(a): Residents' number of outgoing and incoming social ties (i.e., outdegree and indegree effects respectively) will relate to changes in their perceptions of their disability-related health.

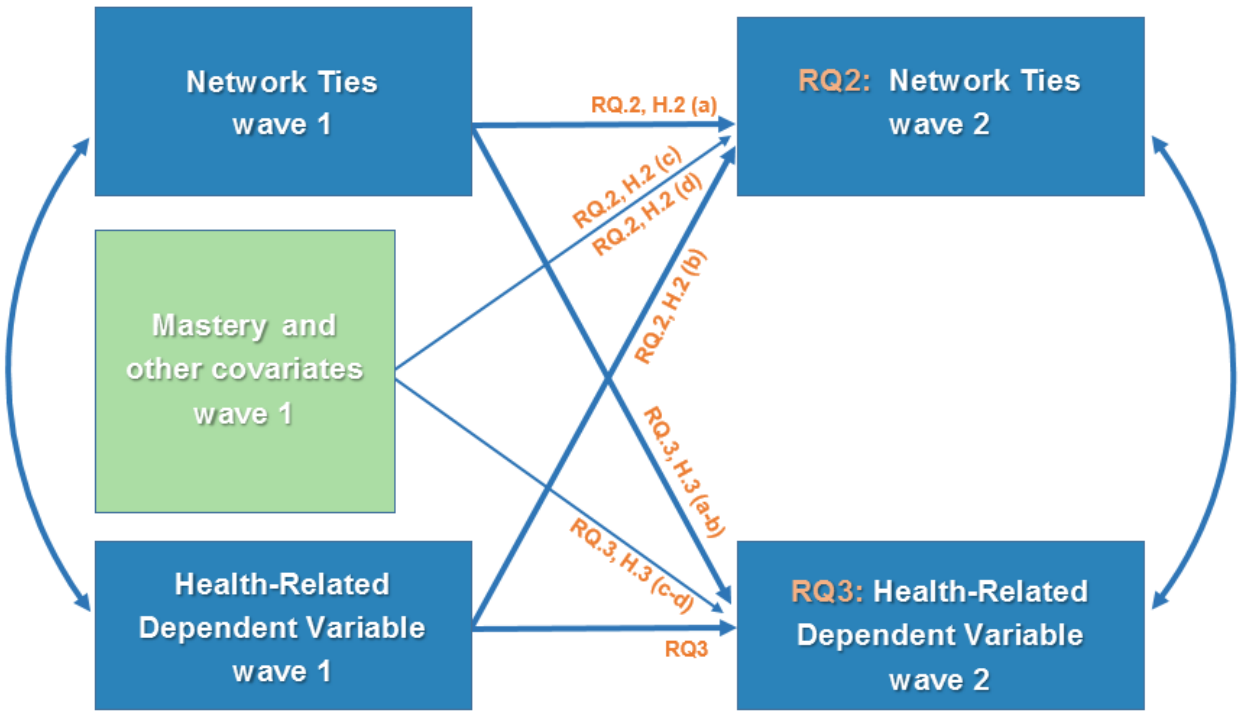
H.3(b): The health status of a resident's alters (i.e., average alter effect or total alter effect, indicative of social influence) will relate to changes in the resident's disability-related health.

H.3(c): A resident's level health at wave 2 will relate to his or her level of mastery at wave 1.

H.3(d): A resident's level health at wave 2 will relate to age, gender, education, loneliness, participation in group activities.

To test these hypotheses, this study assesses the social relationship ties and disability-related health of a group of ALF residents and re-assesses their social ties and health three months later. Figure 3 presents a conceptual map for Research RQ.2and RQ.3 showing the hypotheses associated with each research question.

Figure 3: Conceptual model for the dynamics of networks and health



Chapter 3: Methods

Overview

This research uses a longitudinal panel social network analysis (SNA) design to examine changes in the social networks, physical limitations, cognitive functioning, and depressive symptoms of residents of an assisted living facility (ALF) over a three month period of time. All residents of the facility who were cognitively able to provide informed consent were invited to participate in two waves (wave 1 and wave 2) of data collection during which "network-behavior panel data" (Steglich, Snijders, & Pearson, 2010, p. 332) were gathered. In the terminology of SNA, the changes in the disability-related health outcomes over time are referred to as "behavior dynamics" (Snijders, Steglich, & Schweinberger, 2007, p. 16). Analyses were conducted using descriptive SNA statistics and stochastic actor-oriented models (SAOMs) for network and behavior dynamics to examine the co-evolution of network characteristics and disability-related health outcomes.

Setting

The study site was a medium to large ALF in Houston, TX, with approximately 85 residents living in the assisted living portion of the facility. The residents' age range was from approximately 60 to 100 years old with a median age of approximately 85 years old. A large majority (approximately 95%) of the residents were non-Hispanic White and most were female (approximately 70%). Around another 50 residents lived in an onsite memory care unit in a section of the building that was physically separate from the assisted living section where staff provided care to residents with moderate to severe dementia.

Recruitment and Sample

Inclusion criteria for the dissertation research were residence in the assisted living portion of the ALF and capacity to provide informed consent as measured by a score of 4 or higher on the Six-

Item Screener for cognitive impairment (Callahan, Unverzagt, Hui, Perkins, & Hendrie, 2002). Residents who scored less than 4 on the screener (*n* = 25) and those residing in the memory care unit were excluded from participation. Efforts were made to invite all eligible residents to participate in the study. Recruitment occurred in a variety of ways during the month of August 2017. The ALF administration introduced the study to residents in a letter that contained a recruitment flyer and announced an information session to be held at the facility. The recruitment flyer was also posted in common areas in the facility. At the information session, the principal investigator (PI) described the project and answered residents' and family members' questions. Following the information session, the research team—which included the PI and three research assistants who were trained in the study protocols and responsible conduct of research—staffed a recruitment table in a common area of the ALF for five days. They screened and enrolled participants into the study during this time. After this week of recruitment, an ALF employee went to the apartments of residents who did not come to the recruitment table and asked if the resident would be interested in speaking with the research team about the project. If so, they met with a member of the research team individually to discuss participation. During the recruitment period, residents were given postcards to use to refer other residents to the study and earn $5 worth of "Belmont Bucks"—a specialized currency that could be used in the facility to purchase sundries.

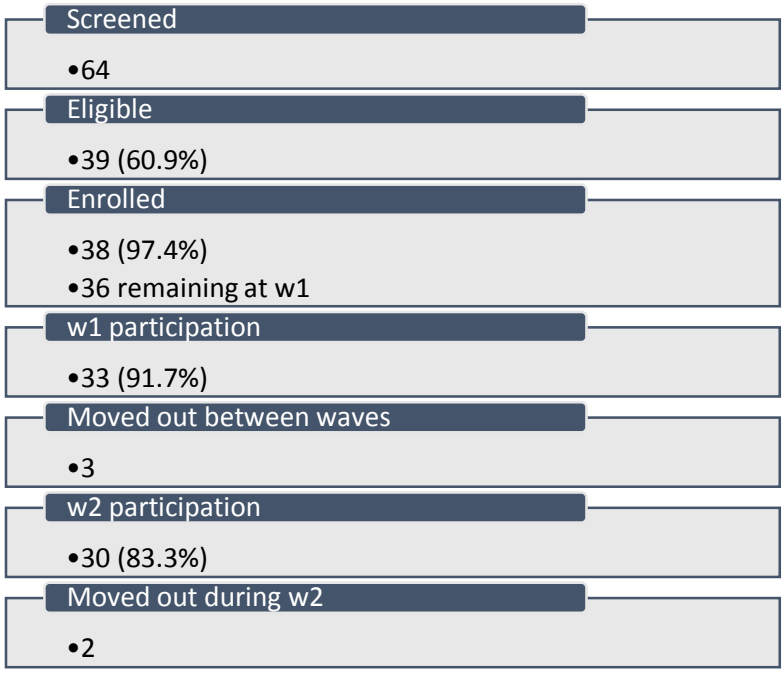
Potential participants were screened for eligibility in private meetings with research staff where staff administered the brief cognitive screener. If the resident was eligible and wished to participate, the research team member reviewed the informed consent form with the resident, answered questions, and obtained written consent. In addition to the consent form, the participant completed a locator form to use in scheduling interviews for the survey administration.

Sixty-four of the estimated 85 residents (75.3%) were screened for eligibility (see Figure 4). Not all residents were screened because some were not cognitively able to complete the screening and a few did not wish to be screened. Of those who were screened, 39 (60.9%) were eligible. Thirty-eight of the 39 (97.4%) enrolled in the study. Two of the participants died prior to completion of the first wave of data collection and were removed from analysis. This resulted in a network defined as 36 residents (*N*=36) who were living, passed the screener, and had consented to participation. Of this defined network, 33 residents (91.7% participation rate) completed a survey during the first wave of data collection. One participant permanently moved out of the facility between wave 1 and wave 2, leaving 35 of the original 36 participants in the facility at wave 2. In the second wave of data collection, 30 participants (83.3% of the defined network) completed the survey, including one who had not completed the survey at wave 1, resulting in 29 participants who completed surveys in both waves.

Data Collection and Data Management

Primary survey data, interview and field notes, and archival data were used in this dissertation research. In addition, the survey was piloted with five residents of a federally subsidized independent living apartment run by the Houston Housing Authority prior to the start of data collection at the ALF.

Figure 4: Rates of screening, eligibility, enrollment, participation, and turnover.



Survey data.

Surveys were administered to participants in face-to-face interviews with the PI and two of the research assistants. The data collection period for wave 1 lasted from August 17 to September 4, 2017.[5] The data collection period for wave 2 was from November 15 to December 18, 2017. The interviews at wave 1 and wave 2 consisted of the same questionnaire which measured social relationships, health outcomes, and covariate variables. Data for the portion of the survey that assessed individual-level attributes were collected via an offline Qualtrics survey on a tablet. The portion of the survey that assessed relationship ties between residents was administered using paper-

[5] Data collection was interrupted by Hurricane Harvey, which caused extensive flooding in Houston, TX, and made transportation to the ALF impossible from August 26 through August 30, 2018. Twenty-nine of the 33 survey respondents (87.9%) completed their surveys before the flooding. The number of participants interviewed after Hurricane Harvey was small, making it unfeasible to analyze if there were any statistically significant differences in the responses of participants before and after the flooding event. However, the four participants who were interviewed after Hurricane Harvey were asked if they believed their responses would have been different prior to the flooding were recorded in interview notes. Only one respondent indicated a potential difference, stating there was increased contact by phone with family members as a result of the hurricane.

and-pen answer sheets. The interviews lasted between 40 minutes and two hours. Participants were offered $10 worth of "Belmont Bucks" for each interview they completed.

The Qualtrics survey response was uploaded to the Qualtrics server prior to the data collector leaving the ALF. These data were downloaded from the Qualtrics survey in .csv format to a University of Houston computer. Data from the answer sheets were entered into a Microsoft Excel spreadsheet by the PI. These data were entered twice and compared to ensure accuracy.

Interview notes recorded information about interviews survey administration that could inform data analysis and interpretation (e.g., if a participant seems to have difficulty responding to the survey questions). Field notes recorded information about the facility and activities that occurred on site. These notes were not qualitatively analyzed to answer research questions for this dissertation, but rather were used to provide context for discussions of the study's findings (see Chapter 6).

Measures

Health measures.

The disability-related health outcomes for the analyses are physical limitations, cognitive functioning, and depressive symptoms. *Physical limitations* were assessed through self-report from a list of seven activities of daily living (ADLs) and ten instrumental activities of daily living (IADLs). Limitations in ADLs and IADLs are traditionally used in clinical and social gerontology to measure disability; however, there is not one standardized list that researchers use (Verbrugge, 2016). This study assessed limitations in ADLs and IADLs using the instrument from Wave 5 of the Hispanic Established Populations for the Epidemiologic Study of the Elderly (Markides, Ray, Angel, & Espino, 2009). The number of limitations was summed for a value representing the total number of activities

the participant could not perform without help. This method is commonly employed in aging- or disability-related research (Chatterji et al., 2015).

Cognitive functioning was assessed using the Mini Mental State Exam (MMSE) which consists of thirty items and takes approximately five to ten minutes to administer (Folstein, Folstein, & McHugh, 1975). Correctly answered responses are totaled for a scores that can range from 0 to 30. The MMSE has been validated for use with older adults and exhibits high test-retest reliability of between .83 and .99 (Folstein et al., 1975). It is one of the most common short cognitive tests in use (J. Brown, 2015). Some participants could not complete portions of the MMSE (between 0 to 3 items) due to a being physically unable to perform the tasks associated with an item (e.g., not being able to copy a drawing due to impaired vision or shaking hands). In this event, missing item responses were not imputed for the cognitive functioning value, rather the total number of items attempted and correctly answered were used. This method has been shown to be acceptable when no cases have more than six missing items (Godin, Keefe, & Andrew, 2017).

Depressive symptoms were assessed during the face-to-face interview using the 15-item version of the Geriatric Depression Scale (GDS) (Sheikh & Yesavage, 1986). The 15-item GDS has been validated with older adults and found to have a Cronbach's alpha reliability coefficient of .80 (Chattat, Ellena, Cucinotta, Savorani, & Mucciarelli, 2001). It is an easily administered self-rated scale consisting of 15 yes/no questions about how the respondent has felt in the previous week. Scores of 5 and higher on the GDS are considered indicative of being at risk for depression (Prakash, Gupta, Singh, & Nagarajarao, 2009). The scale is tailored for the assessment of depressive symptoms in older adults and includes questions such as "Have you dropped many of your activities and interests?" and "Do

you feel it is wonderful to be alive now?" In the present study, the Cronbach-alpha reliability for the 15-item GDS was .76 at wave 1 (*n* = 33) and .78 at wave 2 (*n* = 30).

Individual-level covariates (exogenous factors).

Mastery was measured using the 7-item Pearlin Mastery Scale (Pearlin & Schooler, 1978). This scale is commonly used in research (Eklund, Erlandsson, & Hagell, 2012) and has demonstrated a Cronbach's alpha of between .74 and .94 in samples of older adults (Cairney & Krause, 2008; McKinley, Brown, & Caldwell, 2012). It includes items such as, "I can do just about anything I really set my mind to do" and "There is little I can do to change many of the important things in my life." Each item was scored on a 4-point scale from Strongly Disagree to Strongly Agree, then summed for a total scale score (Pearlin & Schooler, 1978). The Cronbach's alpha reliabilty for wave 1 was .60 (*n* = 33) and for wave 2 was .73 (*n* = 30).

Loneliness was measured with the three-item loneliness scale derived from the Revised UCLA Loneliness Scale (Russell, Peplau, & Cutrona, 1980) that was developed and validated using data from the Health and Retirement Survey (Hughes, Waite, Hawkley, & Cacioppo, 2004). The scale asks (1) How often do you feel you lack companionship? (2) How often do you feel left out? and (3) How often do you feel isolated from others? The response options are *hardly ever*, *some of the time*, and *often* and are scored on a scale from 1 to 3. The three-item loneliness scale has demonstrated reliability coefficients from .72 to .87 in previous research (Hughes et al., 2004; Kim & Fredriksen-Goldsen, 2016). In this study, Cronbach's alpha for wave 1 was .72 (*n* = 33) and for wave 2 was .80 (*n* = 30).

Social networks.

To measure the social networks of residents, participants were asked to report on their relationship ties with other residents in four domains: companionships, acquaintances (weak ties),

social support given and received, and negative interactions. The network assessment began by presenting participants with a roster of all eligible residents who had given consent. Participants were asked to identify individuals with whom they had interacted in the past three months. From this subset, ties were assessed by asking the participant to describe the relationship using questions modified from the Positive and Negative Social Exchanges (PANSE) scale (Newsom et al., 2005). The PANSE is a validated scale that measures the frequency of overall exchanges in the domains of companionship, instrumental support, informational support, emotional support and negative interactions. It consists of 12 questions assessing positive exchanges and 12 items that assess negative interactions. Each subscale has demonstrated a Cronbach's alpha of .90 (Newsom et al., 2005). The modifications to the PANSE items entailed making the questions specific to each alter rather than to relationships in aggregate. Each question about network ties was prefaced with the time frame, "Thinking of the past three months."

Companionship.

Companionship ties were assessed with the question, "Did [alter] provide you with good company and companionship, include you in things they were doing, or do social or recreational activities with you?" A matrix representing the companionship network was constructed with x_{ij} = 1 if the respondent indicated a companionship relationship existed with alter j, and x_{ij} = 0 if the respondent indicated there was not a companionship relationship with alter j. If the respondent did not complete the survey the value for x_{ij} was missing. For the one participant who left the facility after wave 1, outgoing and incoming ties at wave 2 were considered *structural zeroes*, a construct used in SAOMs to indicate a tie is not possible (Ripley et al., 2017).

Acquaintance.

Acquaintance ties were assessed for alters with whom a companionship tie was not indicated. Acquaintances were assessed with the questions, "Would you consider [alter] an acquaintance (someone you know slightly but is not a close friend, e.g., exchange small talk)?" As with the companionship network, the acquaintance network matrix consisted of x_{ij} = 1 if the respondent indicated an acquaintance existed with alter j, and x_{ij} = 0 if the respondent indicated there was not an acquaintance. If the respondent did not complete the survey the value for x_{ij} was missing. For the one participant who left the facility after wave 1, outgoing and incoming acquaintance ties at wave 2 were considered structural zeroes.

Enacted social support

Enacted social support ties were assessed along the dimensions of information support ("offer you helpful advice when you needed to make important decisions, make useful suggestions, or suggest ways that you could deal with problems you were having"), instrumental support ("do favors and other things for you, provide you with aid and assistance, or help you with an important task or something that you could not do on your own?"), and emotional support ("provide you with emotional support, that is do or say things that were kind or considerate toward you, cheer you up or help you feel better, or discuss personal matters or concerns with you?"). For each of these three types of enacted social support, respondents indicated both whether they had given and whether they had received support. A matrix was constructed for enacted support such that x_{ij} = 1 if actor i indicated giving any of the three types of support to alter j, or if j indicated receiving support from i. As a result of using the complementary network information about support received, missing data existed for x_{ij} only in the event that both i and j were non-respondents. For the participant who left

the facility after wave 1, outgoing and incoming enacted support ties at wave 2 were considered structural zeroes.

Negative interactions.

Negative interactions were also assessed bi-directionally; the items asked about negative behavior done by the respondent to each alter as well as by the alters to the respondent. The items for negative interaction were (1) unwanted advice, questioning or doubting decisions, or interfering or meddling in personal matters, (2) letting the person down when help was needed, asking for too much help, or failing to give assistance that the person was counting on, (3) leaving out of activities the person would have enjoyed or forgetting, ignoring, or failing to spend enough time with the person, and (4) doing things that were thoughtless or inconsiderate, acting angry or upset, or acting unsympathetic or critical about personal concerns. A matrix was constructed for the negative interaction network such that x_{ij} = 1 if actor i indicated engaging in any of the four types of negative interaction toward alter j, or if j indicated being on the receiving end of a negative interaction from i. Missing data existed for x_{ij} only in the event that both i and j were non-respondents. For the participant who left the facility after wave 1, outgoing and incoming negative interaction ties at wave 2 were considered structural zeroes.

Archival data.

Upon enrollment into the study, participants provided authorization for the ALF to release personal information from records at the ALF. Archival data included move in date, attendance records for facility-sponsored group activities, and if applicable, move out date. These archival data were collected after primary data collection for wave 1 was completed. The archival data were provided in handwritten form. Members of the research team entered the archival data into a

Microsoft Excel spreadsheet as soon as possible after receiving it and shredded the original documentation.

Analytic Strategy

RQ.1 (describe the structure of the networks).

To answer RQ.1[6], statistics providing a basic description of the networks in terms of the amount and distribution of social ties in the networks, and the networks' cohesion were calculated. Density, average degree, number of ties, and reciprocated ties were calculated excluding missing values using RSiena package version 1.2-4 (Ripley et al., 2017) in R version 3.4.3 (R Core Team, 2013). Transitivity, network centralization, and number of isolates were calculated using UCINET version 6.647 (Borgatti, Everett, & Freeman, 2002). Homophily in the networks for each disability-related measure was assessed using Moran's i network autocorrelation indices (Steglich et al., 2010) in UCINET with 10,000 network permutations run to determine statistical significance of the measures. Static visualizations of the four social networks at wave 1 and wave 2 were made using igraph package version 1.1.2 (Csardi & Nepusz, 2006) in R.

RQ.2 and RQ.3 (dynamics of residents' social networks and disability-related health).

Preliminary analyses to address RQ.2[7] and RQ.3[8] examined the four networks and three disability-related dependent variables at wave 1 and wave 2. The preliminary analyses described the

[6] RQ.1: What is the structure of the social networks (e.g., density, centralization, average degree, number of isolates, reciprocity, transitivity, homophily, stability over time) of residents of an ALF accounting for four types of social relationships – companionships, acquaintances, social support, and negative interactions?

[7] RQ.2: How do ALF residents' disability-related health and social factors relate to changes in network ties in each of the four networks?

[8] RQ.3: How do ALF residents' social factors and initial levels of disability-related health relate to changes in ALF residents' disability-related health?

amount of change in the networks and disability-related health over time and provided information for the assumptions for the more complex network analyses that followed.

The following preliminary analyses were conducted:

- *Network change.* Network change between wave 1 and wave 2 was examined using Jaccard indices and total number of ties either dropped or added.
- *Missing data*. In SAOMs, some missing data can be imputed without severely biasing parameter estimates (Huisman & Steglich, 2008); less than 20% missing data on any variable including network ties is generally acceptable (Ripley et al., 2017). This study's network data were assessed to determine if there were more than 20% missing on any variable. Across all models, there was a maximum of 16% missing data for network ties, 12.5% for disability-related health dependent variables, and 8.3% for individual-level covariates.
- *Extreme values*. Individual-level attribute variables were examined for extreme values by standardizing scores and considering any z-score greater than 3.29 extreme (Tabachnick & Fidell, 2014). There were no extreme values in the data.
- To provide an initial understanding of the change in the disability-related health of residents before controlling for social network factors, paired samples t-tests were conducted on each of the three behavioral dependent variables (i.e., cognitive functioning, physical limitations, and depressive symptoms), assessing change between wave 1 and wave 2. The t-tests found no significant change in any of the three disability-related health factors (see Table 2 in Chapter 4).

- *Homophily*. Statistical tests for homophily were conducted using a widely used test for network autocorrelation, Moran's i (Steglich et al., 2010). Autocorrelation statistics measure the degree to which actors who are close to one another in the network have similar (or dissimilar) attribute values. Moran's i statistics were calculated and statistical significance was determined through permutation testing with 10,000 network permutations in UCINET. Moran's i scores can range from -1 (perfect negative correlation) through 0 (no correlation) to +1 (perfect positive correlation). Statistical significance for Moran's i was set at $\alpha < .05$.

Based on the results of the relevant preliminary tests, it was concluded that there were no problems with the data or violations of model assumptions.

Description of stochastic actor-oriented models (SAOMs).

Stochastic actor-oriented models (SAOMs) for network and behavior dynamics were conducted to answer RQ.2 and RQ.3. SAOMs for network and behavior dynamics (also called co-evolution models) are flexible models of network and individual-level change. They estimate parameters for endogenous and exogenous effects on (1) the probability that a network tie is created or maintained (i.e., network dynamics) and (2) changes in individual-level attributes (i.e., behavior dynamics), using network-behavior panel data (Snijders et al., 2010). Because SAOMs for network and behavior change concern the co-evolution of relationships and individual-level attributes, network ties and individual-level attributes are both dependent and independent variables in the models. In addition to network and behavioral dependent variables, individual and dyadic-level covariates can also be included in co-evolution SAOMs. The strength of the co-evolution model is

that it can estimate the effects of social relationships on disability-related health outcomes while controlling for other relationship types and individual-level attributes (Ripley et al., 2017).

There are two components of a co-evolution SAOM. The *network dynamic* part has the set of network ties as the dependent variable and co-evolving behavior as the independent variable. This is this part of the model that examines social influence. In the *behavior dynamic* part of the model, the individual-level attribute is the dependent variable and the network ties are the independent variable. The behavior dynamic part of the model examines social influence on behavior via parameters for effects such as the alters' levels of the behavioral dependent variable (e.g., *average alter* effect or *total alter* effect) or similarity of actors on the behavioral dependent variable (e.g., *average similarity* effect or *total similarity* effect) (Ripley et al., 2017).

Parameter estimates for the various effects included in a SAOM are obtained using an "iterative stochastic simulation algorithm" (Ripley et al., 2017, p. 15). The algorithm seeks to find parameter values that will approximate the observed network and values for the behavioral dependent variable in simulated networks. In the phases of the algorithm, rough parameter estimates are calculated and then updated iteratively as the results of simulations are compared to the observed network. Once a final set of parameter estimates is achieved for a given estimation run, the next phase simulates many networks and compares the average counts and values from the simulations to the observed network. This comparison results in an overall maximum convergence ratio which should not exceed .25 and t-statistics for each parameter for which the absolute value of which should not exceed .10 (Ripley et al., 2017). If maximum convergence ratio and t-statistics do not meet these criteria, the model is said not to converge. Models that do not converge initially can be rerun or re-specified to achieve convergence (Ripley et al., 2017).

Assumptions and data requirements of SAOMs.

There are six basic assumption of stochastic actor-oriented models or SAOMs. The first is the assumption of continuous time; that network change occurs in discrete small steps (Snijders et al., 2010). The second assumption is that network dynamics are a result of a Markov process (i.e., at any time, the state of a network probabilistically predicts its future state with no additive effects from a previous time). Third, it is assumed that only one tie change or a one unit change in the behavior occurs in a discrete step, thereby reducing network and behavior dynamics to a series of the smallest changes possible. Fourth is the assumption that control of outgoing ties and behavior attributes lies with the ego. Fifth, the processes which determine the rate at which behavior change and tie change choices can be made are unrelated. The sixth and final assumption is that the processes that determine the amount and direction of tie and behavior changes are also distinct, resulting in unrelated parameters for the two types of change (Snijders et al., 2010). These SAOM assumptions generally align with basic assumptions of reality or are useful heuristics in understanding reality (e.g., that time is continuous or that time can be divided into small enough discrete portions in which only one thing happens). It is helpful to consider whether there is any reason to suspect the nature of reality in the networks being examined in a SAOM might violate these assumptions of reality. For example, individual actors may not have control over their outgoing collaboration ties in a classroom where teachers assign workgroups for students. However, there were no reasons to suspect these understandings of time or social choices are violated in the context of the social networks of the residents in the ALF.

Snijders, Van de Bunt, and Steglich (2010) provide guidance on applying the assumptions noting, “the assumptions should be plausible in an approximate sense, and the data should contain

enough information" (p. 49). They further state in order to conduct analyses using SAOMs there should be at least two panel waves, generally at least 20 individuals in the network, and at least 40 additions and/or losses to the ties of the dependent variable network between the two time points (Snijders et al., 2010). However, if there are too many changes between panel waves, the assumption of a gradually changing network is violated. To assess for this, the Jaccard index can be used. The formula for the Jaccard index is:

$$\frac{N_{11}}{N_{11} + N_{01} + N_{10}},$$

where N_{11} equals the total number of ties at both waves, N_{01} equals the number of new ties created at the second wave and N_{10} equals the number ties that existed at the first wave that do not exist in the second wave. Ideally, to use a SAOM, the Jaccard index should be greater than .3. Values less than .2 suggest the assumption has been violated (Snijders et al., 2010).

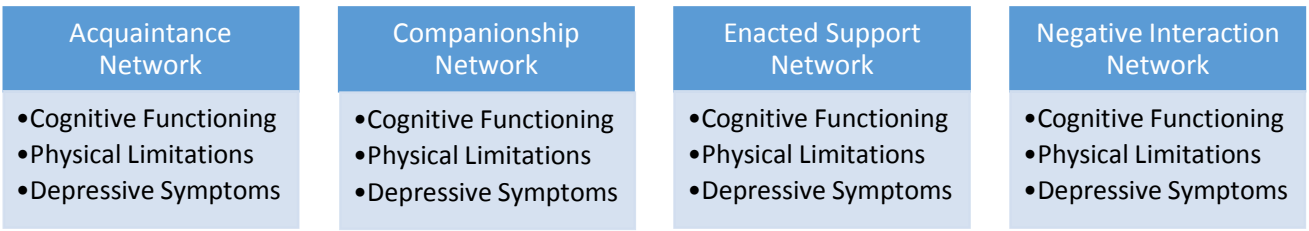
SAOMs for RQ.2 and RQ.3.

The analyses for this dissertation included 12 separate SAOMs (see Figure 5) for each combination of the four relationship types (i.e., companionship, acquaintance, enacted support, and negative interaction) and three disability-related health factors (i.e., physical limitations, cognitive functioning, and depressive symptoms). The algorithm for all models used 3,000 simulated networks in the final phase which were used to calculate parameter standard errors, t-statistics, overall maximum convergence ratios, and in goodness of fit testing.

To address all of the hypotheses associated with RQ.2 and RQ.3 for each network/behavior combination, 40 effects were needed (see Table 1). This includes effects that are recommended or required to estimate a co-evolution SAOM (Snijders et al., 2010) labeled as "Default effects" and those that may help the models converge and provide a good fit (i.e., return a result in which the

estimated parameters are able to simulate networks that are similar to the observed network). One of these is the rate parameter which describes the number of times each actor was given an opportunity to make a change in either network ties or level of disability-related health in the model estimation (Snijders et al., 2010). Non-significant rate parameters indicate no change in the network or behavior dynamics. The shape parameters for behavior dynamics are also default effects used as controls. They indicate the direction and quality of change (linear or quadratic) in values of disability-related health variables over time (Snijders et al., 2010). The default effects were not central to addressing this dissertation's hypotheses so they are presented, but not discussed in the results section.

Figure 5: Twelve SAOMs to test hypotheses of RQ.2 and RQ.3



Note: Four types of social networks and three disability-related dependent variable result in 12 combinations for co-evolution models.

Computationally, there can be difficulties estimating a model with so many parameters and the relatively small network size (N = 36) resulting in a lack of convergence during the estimation process. To avoid this, a basic model that excluded the covariate effects—that is H.2(d) and H.3(d)—for each of the 12 network/behavior combinations was initially run. If the basic model did not find statistically significant parameters for either behavior effects on network dynamics—H.2(b)—or network effects on behavior dynamics—H.3(b) and H.3(c), the full model with covariate effects was not attempted. This was the case for each of the 12 models. Result presented in Chapter 4 show

parameter estimates, convergence diagnostics and goodness of fit for the basic models, which consist of Effects 1-13 and 29-35 in Table 1.

Table 1: Hypotheses and RSiena effects associated with RQ.2 and RQ.3

Research Question/Hypotheses	**Corresponding RSiena Effect Names**
NETWORK DYNAMICS RQ.2: How do ALF residents' disability-related health and social factors relate to changes in network ties in each of the four networks?	
Default effects	1. basic rate parameter 2. outdegree (density)
H.2(a): Endogenous structural factors related to the creation or maintenance of network ties in each of the four networks from wave 1 to wave 2 include reciprocity, transitivity, a tendency for variation in residents' degree of activity in the network (i.e., outdegree activity), a tendency for variation in residents' degree of popularity (i.e., indegree popularity), and a tendency for residents who are active in the network to also be more popular (i.e., outdegree popularity).	3. reciprocity 4. transitive triplets 5. 3-cycles 6. indegree-popularity 7. outdegree-activity 8. outdegree-popularity
H.2(b): A resident's disability-related health (i.e., physical limitations, cognitive functioning, or depressive symptoms) at wave 1 and wave 2 will relate to the likelihood of the maintenance or creation of outgoing network ties (i.e., ego effects) and incoming network ties (i.e., alter effects). In addition, network ties at wave 2 will be more likely between residents who have similar levels of disability-related health (i.e., similarity effect, which indicates a social selection process).	9. beh ego 10. beh alter 11. beh similarity
H.2(c): A resident's level of mastery at wave 1 will relate to the likelihood of creating or maintaining network ties.	12. mastery ego 13. mastery alter
H.2(d): Covariates at wave 1 that relate to the maintenance or creation of network ties include age, gender, education, loneliness, participation in group activities, and propinquity (i.e., ego and alter living on the same floor).	14. age ego 15. age alter 16. age similarity 17. gender ego 18. gender alter 19. gender similarity 20. edu ego 21. edu alter 22. edu similarity 23. loneliness ego 24. loneliness alter 25. # activities attended ego 26. # activities attended alter 27. X, same activity 28. X, same floor

Research Question/Hypotheses	**Corresponding RSiena Effect Names**
BEHAVIOR DYNAMICS RQ.3: How do ALF residents' social factors and initial levels of disability-related health relate to changes in ALF residents' disability-related health?	
Default effects	29. rate beh period 1 30. beh linear shape 31. beh quadratic shape
H.3(a): A resident's number of outgoing and incoming social ties (i.e., outdegree and indegree effects respectively) will relate to changes in his or her disability-related health.	32. beh indegree 33. beh outdegree
H.3(b): The health status of a resident's alters (i.e., average alter effect or total after effect, indicative of social influence) will relate to changes in the resident's disability-related health.	34. beh avAlt (or beh totAlt)
H.3(c): A resident's level health at wave 2 will relate to his or her level of mastery at wave 1.	35. beh: effect from mastery
H.3(d): A resident's level health at wave 2 will relate to age, gender, education, loneliness, participation in group activities.	36. beh: effect from age 37. beh: effect from gender 38. beh: effect from education 39. beh: effect from loneliness 40. beh: effect from # activities attended

A model was deemed to converge if t-ratios for each parameter estimate were < .1 and the overall maximum convergence ratio was < .25. In addition, multicollinearity was assessed by looking at the correlation of the parameters in covariance matrix of estimates. If $r > .98$ for any two parameter estimates, one of the parameters was dropped from the model based on which one made the most theoretical sense to remove. Not all models converged with the basic model effects described above. In these cases, the effects specified in the model were revised to achieve convergence (Ripley et al., 2017). For example, some models did not converge when estimating the effect of the average of alters' behavior was specified, but did converge when the effect of the total of the alters' behavior was included instead.

To test the final models' validity, goodness of fit tests assessing the difference between observed and simulated values for the distribution of indegree, outdegree, geodesics, and triad census and values on the behavioral dependent variable were conducted using the SienaGOF function (Ripley et al., 2017). A good fit was defined as $p > .05$. A good fit was obtained for each of the twelve models. The results of these SAOMs are presented in the following chapter.

Chapter 4: Results

This chapter begins with a description of the study's sample at wave 1 and wave 2 and then presents descriptive statistics and visualizations for each of the four social networks examined in this dissertation. These sections include results from the study's preliminary analyses. Together, they provide a foundation for understanding the results from the stochastic actor-oriented models (SAOMs) for network and behavior dynamics that are presented at the chapter's end.

Sample

As anticipated based on the overall composition of the ALF, the sample was predominantly non-Hispanic White, mostly female, and highly educated. The average age was 82 years old (*SD* = 8.8 years). The majority were widowed. Overall, participants had low levels of depressive symptoms and reported having an average of five physical limitations. Because eligibility was conditioned on passing a cognitive screener, the sample exhibited high levels of cognitive functioning with little variance in scores. Univariate analyses found no significant changes between wave 1 and wave 2 on the disability-related health variables (physical limitations, cognitive functioning, and depressive symptoms). Table 2 contains detailed information about the sample at wave 1 and wave 2.

Univariate Descriptions of the Social Network (R.Q. 1)

Acquaintances were the most frequently reported type of relationship among the ALF residents, followed by enacted support ties, companionships, and negative interaction ties. Table 3 presents detailed network descriptive statistics for each network at wave 1 and wave 2, which are described in the subsections below.

Table 2: Sample descriptive statistics

	Wave 1 (*n* = 33)		Wave 2 (*n* = 30)				
	n	***%***	***n***	***%***			
Female	22	66.7	21	63.6			
Hispanic	2	6.1	2	6.1			
Race (select all that apply)							
White	32	97.0	29	87.9			
African American/Black	0	0.0	0	0.0			
Asian	1	3.0	1	3.0			
American Indian/Alaskan Native	2	6.1	2	6.1			
Other	1	3.0	1	3.0			
Education							
Less than high school	0	0.0	0	0.0			
High school graduate or equivalent	4	12.1	2	6.1			
Some college/Associate degree	6	18.2	6	18.2			
College degree	14	42.4	15	45.5			
Graduate or higher/Professional degree	9	27.3	7	21.2			
Marital Status							
Single/Never married	3	9.1	3	9.1			
Married/Partnered	7	21.2	7	21.2			
Widowed	20	60.6	19	57.6			
Divorced	2	6.1	1	3.0			
Separated	1	3.0	0	0.0			
					Change Statistics (*n* = 29)		
	M	***SD***	***M***	***SD***	***t***	***df***	***p***
Age	82.2	8.8	82.5	8.4			
Disability-related health factors							
Physical limitations (0-17)	5.1	3.6	5.0	3.1	-.247	28	.807
Cognitive functioning (0-30)	27.1	2.3	26.9	2.7	1.00	28	.326
Depressive symptoms (0-15)	3.0	2.8	2.8	2.7	.273	28	.787
Covariates							
Mastery (7-35)	24.7	4.0	24.7	4.8			
Loneliness (3-9)	4.6	1.8	4.6	1.8			
Length of residence in ALF (in years)	1.9	1.6	2.1	1.4			

Note: Wave 1 (*n* = 33) was conducted in August and September 2017 and wave 2 (*n* = 30) was conducted in November and December 2017.

Acquaintance network.

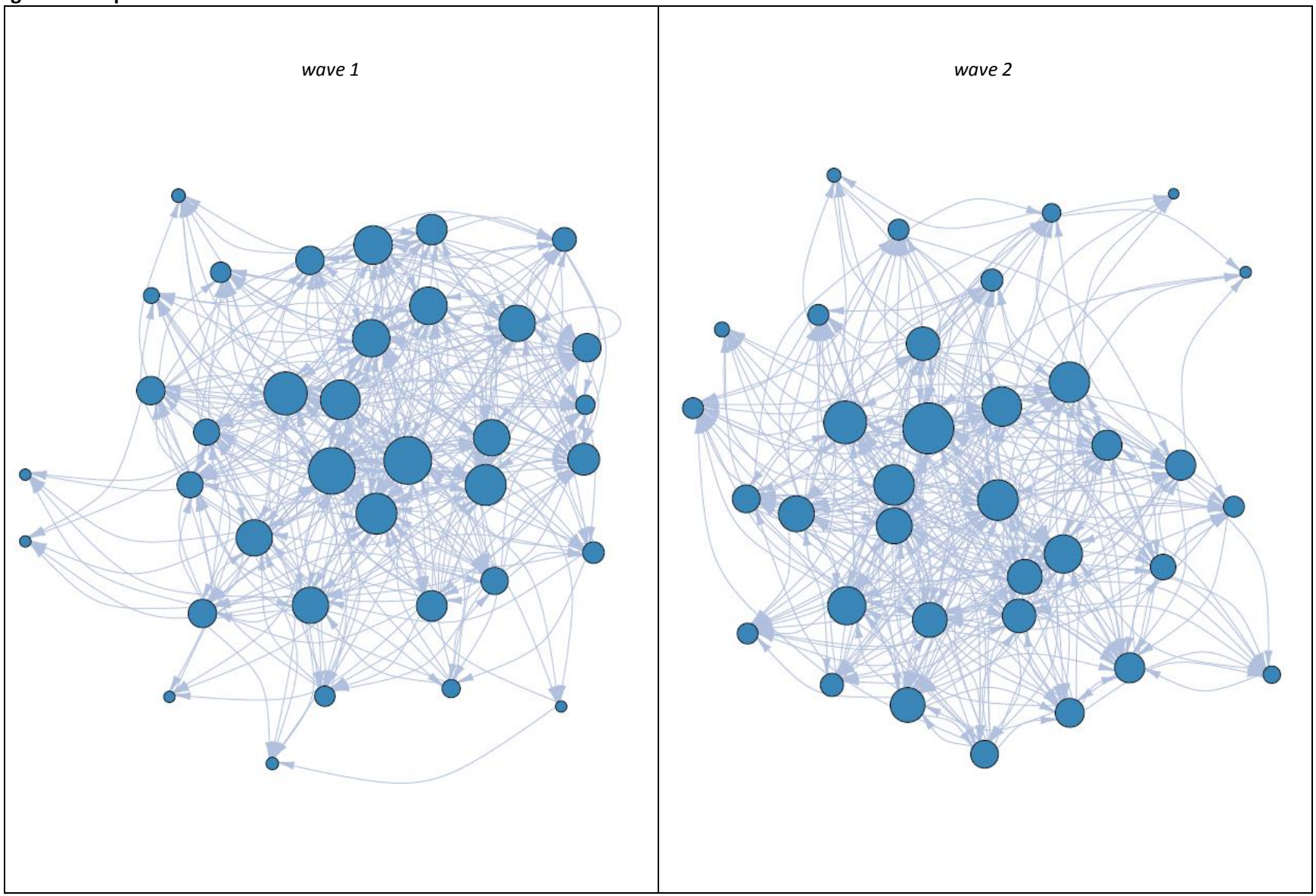
The most common type of relationship found in the ALF was acquaintance. There were an average of about 11 acquaintances per resident and all residents had at least one acquaintance. Univariate descriptive analyses found a moderately high level of centralization in the network indicating some residents were more connected in the acquaintance network than others. Between 40 and 46 percent of the acquaintance ties in the network were reciprocated. Over half of the potential triads in the network were transitive triads; this means that of all of an ego's indirect ties at a path length of two (i.e., "an acquaintance of my acquaintance"), the majority were also an acquaintance of the ego. Although there was a moderate amount of stability in the acquaintance

Table 3: Network descriptive statistics

	Acquaintance		Companionship		Enacted support		Negative interactions	
	w1 (*n*=33)	w2 (*n*=30)	w1 (*n*=33)	w2 (*n*=30)	w1 (*n*=33)	w2 (*n*=30)	w1 (*n*=33)	w2 (*n*=30)
Density (0-1)	.308	.320	.077	.134	.203	.180	.068	.062
Centralization (0-1)	.457	.463	.228	.331	.331	.297	.261	.248
Average degree	10.79	11.21	2.70	4.69	7.089	6.294	2.372	1.835
Number of isolates	0	0	6	4	3	2	6	11
Number of ties	356	349	89	146	254	223	85	65
Reciprocated ties: n (%)	162 (45.5)	138 (39.5)	32 (36.0)	58 (39.7)	190 (74.8)	142 (63.7)	62 (72.9)	48 (73.8)
Transitivity (0-1)	.559	.647	.597	.634	.328	.395	.194	.209
Percent missing (%)	8.3	13.5	8.3	13.5	0.5	1.6	0.5	1.6
Changes from wave 1 to wave 2								
Ties added		155		86		89		39
Ties dropped		157		26		119		59
Ties maintained		193		60		134		26
Jaccard index		.382		.349		.392		.210
Network autocorrelation (Moran's *i*)								
Physical limitations	.039	.013*	-.148	-.098	-.077	-.054	.031	.201
Cognitive functioning	-.047	-.022	.112	-.040	.005	-.009	.006	.058
Depressive symptoms	-.041	-.014	.252**	.127*	.031	-.015	.001	.427**

Note: Network statistics are for four types of social networks among residents in an assisted living facility (N=36) at wave 1 (August and September 2017) and wave 2 (November and December 2017); *$p < .05$, **$p < .01$

Figure 6: Acquaintance network visualizations.



Note. Acquaintances among residents in an assisted living facility (*N*=36) at wave 1 (August and September 2017) and wave 2 (November and December 2017). Network visualizations were created in igraph 1.1.2 using the Kamada-Kawai layout algorithm, a force-directed algorithm which positions nodes in two dimensional space (Gibson, Faith, & Vickers, 2012). The circular symbols representing residents are sized according to the number of acquaintances they have including outgoing or incoming ties. Arrows at the ends of lines connecting residents represent the direction of the acquaintance tie.

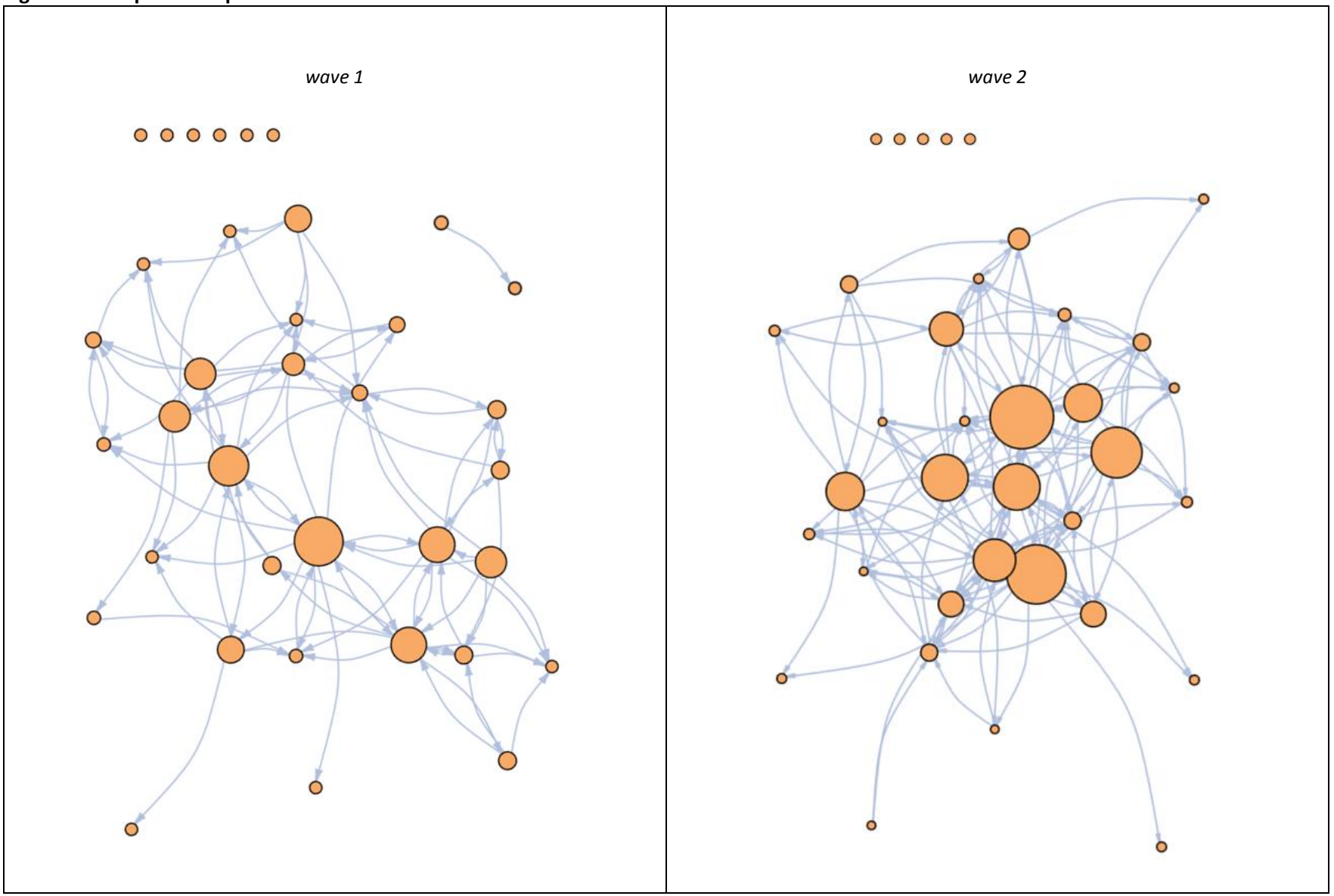
network from wave 1 to wave 2 (Jaccard index of .382), there were 312 ties that were either added or dropped in the three months between waves. Table 3 presents detailed network descriptive statistics and Figure 6 provides a visual representation of the network.

The only disability-related homophily effects found in the acquaintance network were on levels of physical limitation. At wave 2, acquaintances were more likely to exist between residents with similar levels of physical limitations (Moran's i = .013, p = .022). No significant homophily was found for cognitive functioning or depressive symptoms in the acquaintance network at either wave.

Companionship.

Residents had fewer companionship ties on average (2.7 at w1 and 4.7 at w2) than acquaintance ties and there were some participants who reported no companions among the other participants (i.e., were "isolates"). Univariate descriptive analyses found the centralization of the companionship networks was lower than in the acquaintance networks, indicating that there was a more even distribution of the number of companions that residents had. The percent of reciprocated ties (36% at w1, 40% at w2) in the companionship networks was not higher than in the acquaintance networks as might be anticipated by the more intimate nature of companionships. Levels of transitive triads were similar to the acquaintance network indicating that being a companion of one's companions and being an acquaintance of one's acquaintances were common phenomenon in both networks. The companionship network was moderately stable across the three months of the study (Jaccard index = .349); however, a total of 112 companionship ties were dropped or added between wave 1 and wave 2. Table 3 presents detailed network descriptive statistics and Figure 7 provides a visual representation of the network.

Figure 7: Companionship network visualizations



Note. Companionships among residents in an assisted living facility (*N*=36) at wave 1 (August and September 2017) and wave 2 (November and December 2017). Network visualizations were created in igraph 1.1.2 using the Fruchterman-Reingold layout algorithm, a force-directed algorithm which positions nodes in two dimensional space (Gibson, Faith, & Vickers, 2012). The circular symbols representing residents are sized according to the number of outgoing companionship ties reported. Arrows at the ends of lines connecting residents represent the direction of the companionship tie.

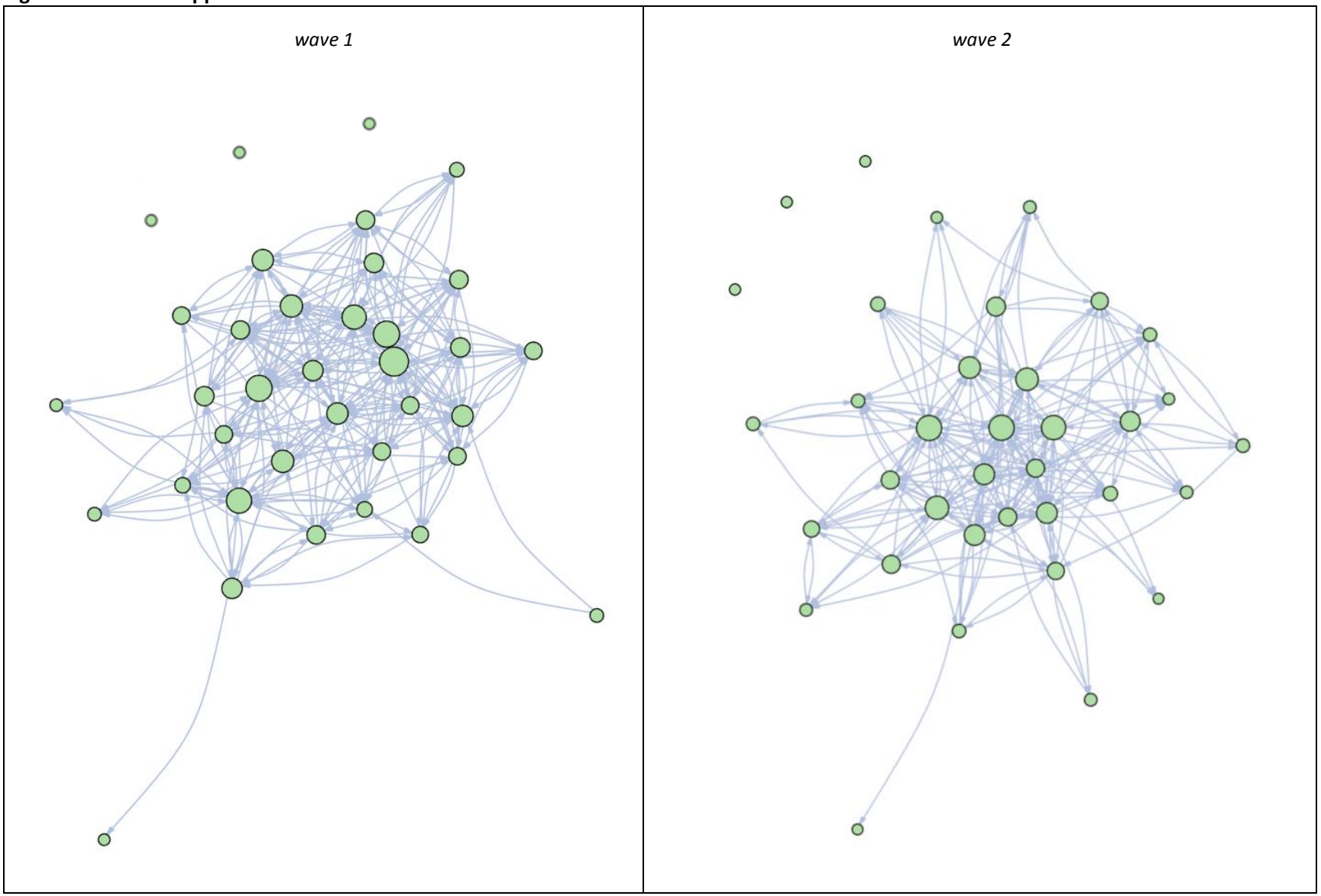
There was significant homophily on depressive symptoms in the companionship networks at wave 1 (Moran's i = .252, p = .009) and wave 2 (Moran's i = .127, p = .023), indicating that companions tended to have similar levels of depressive symptoms. No significant homophily was found for cognitive functioning or physical limitations in the companionship network at either wave.

Enacted social support.

The enacted social support ties were the second most common of the four network types assessed in the ALF. On average there were about six to seven other residents with whom a participant had either given or received support. The level of centralization in the enacted social support networks was comparable to that of the companionship network, indicating a relatively evenly distributed exchange of support among the residents, particularly when compared to the level of centralization in the acquaintance network. As in the companionship network, there were a few residents who were isolates. There was a high level of reciprocity in the enacted support networks and a more modest level of transitivity in the support networks. The enacted support network was the most stable of four types of relationships examined (Jaccard index = .392). Table 3 presents detailed network descriptive statistics and Figure 8 provides a visual representation of the network.

In the enacted support network, there was no significant homophily on disability-related health, meaning that support was not more likely to be exchanged between people who were similar in physical limitations, cognitive functioning, or depressive symptoms. Conversely, there were also no significant *negative* network autocorrelations effects, indicating that support exchanges did not occur between people with larger differences in the disability-related factors (as might be expected if

Figure 8: **Enacted support network visualizations**



Note. Enacted support ties among residents in an assisted living facility (*N*=36) at wave 1 (August and September 2017) and wave 2 (November and December 2017). Network visualizations were created in igraph 1.1.2 using the Fruchterman-Reingold layout algorithm, a force-directed algorithm which positions nodes in two dimensional space (Gibson, Faith, & Vickers, 2012). The circular symbols representing residents are sized according to the number of outgoing enacted support ties reported. Arrows at the ends of lines connecting residents represent the direction of the enacted support tie.

people with greater levels of functioning were helping those with lower levels and potentially greater need).

Negative interactions.

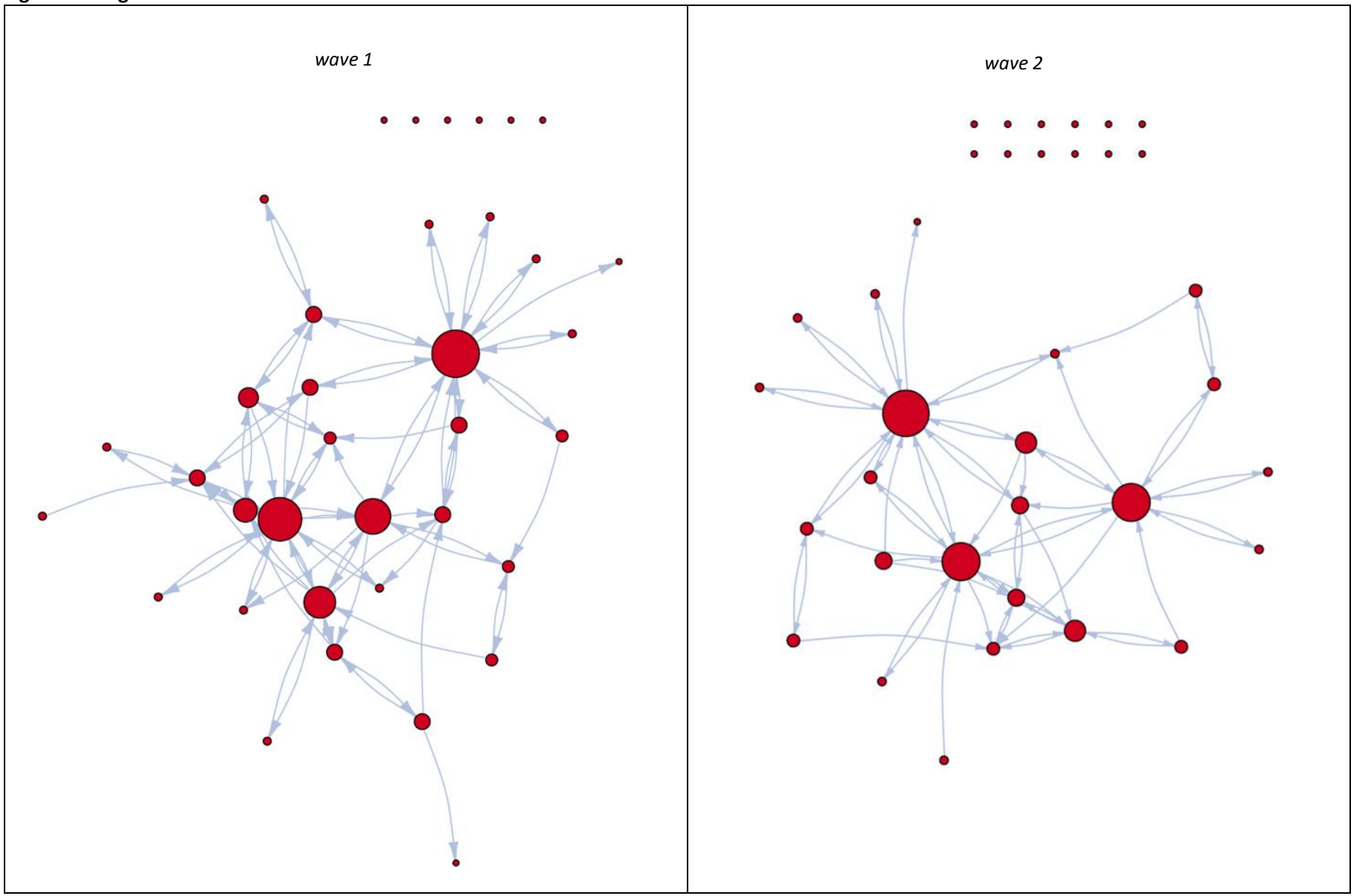
Negative interactions were the least common of the four types of relationships examined in the ALF. Nonetheless, residents had negative interactions with an average of about two other residents. There were substantial number of isolates who did not experience negative interactions with the other residents in the network (six at w1 and 11 at w2). The negative interaction network was the least stable of four network types (Jaccard index = .210), losing 59 ties and gaining 39 between wave 1 and wave 2. At wave 2, there was significant homophily on depressive symptoms (Moran's i = .427, p = .003) indicating negative interactions were more likely to occur between residents with similar levels of depression. Table 3 presents detailed network descriptive statistics and Figure 9 provides a visual representation of the network.

Dynamics of Social Relationships and Disability-related Health (RQ.2 and RQ.3)

Twelve separate basic SAOMs were modeled using each combination of the four types of network ties and three disability-related health factors as dependent and independent variables in the co-evolution models.[9] Mastery was not associated with the trajectories of either social networks or disability-related health as hypothesized in H.2(c) and H.3(c). Hypothesis H.2(b)—that a resident's disability-related health would be related to network ties and that social selection on disability-related health would be a significant effect in the network—was also not supported. Specifically, no significant disability-related health effects were found to predict the maintenance or creation of network ties

[9] Some of the models did not converge using the average disability-related health values of a resident's alters to estimate social influence. To address this, instead of specifying the effect of the *average* alters' health values, the SAOM modeled the *total* health values of a resident's alters, accounting for the number of alters when considering social influence. Results for either effect are shown in Tables 4-7 depending on which effect was specified.

Figure 9: Negative interaction network visualizations.



Note. Negative interaction ties among residents in an assisted living facility (*N*=36) at wave 1 (August and September 2017) and wave 2 (November and December 2017). Network visualizations were created in igraph 1.1.2 using the Fruchterman-Reingold layout algorithm, a force-directed algorithm which positions nodes in two dimensional space (Gibson, Faith, & Vickers, 2012). The circular symbols representing residents are sized according to the number of outgoing negative interaction ties reported. Arrows at the ends of lines connecting residents represent the direction of the negative interaction tie.

in any of the 12 models. Similarly, in none of the 12 models were there statistically significant network effects (i.e., incoming ties, outgoing ties, or social influence) on the disability-related health dependent variables, thereby failing to support hypothesis H.3(a) or hypothesis H.3(b). As a result, the more complex models that would have examined the effects of the covariates of age, gender, education, and loneliness on the co-evolution of health and social networks outlined in H.2(d) and H.3(d) were not estimated.

Endogenous effects on network dynamics across all models - H.2(a).

Hypothesis H.2(a)[10] was partially supported. In all of the models, endogenous effects that were significantly related to network dynamics were (1) negative outdegree (density) effects, (2) positive reciprocity effects, and (3) positive outdegree-activity effects.

1. The negative outdegree (density) effect indicates that, controlling for all other structural effects and individual-level attributes, there is a tendency away from forming social ties (Snijders et al., 2010). This is a common empirical phenomenon in human social relationships given that people have limited amounts of resources to invest in relationships and considering that endogenous effects such as reciprocity and transitivity explain the existence of ties and are controlled for in SAOMs (Lusher et al., 2013; Robins, Pattison, Kalish, & Lusher, 2007).
2. The positive reciprocity effects show a tendency for social ties to be reciprocated (Snijders et al., 2010)—that is, a resident is more likely to form and maintain ties

[10] H.2(a): Endogenous structural factors related to the creation or maintenance of network ties in each of the four networks from wave 1 to wave 2 include reciprocity, transitivity, a tendency for variation in residents' degree of activity in the network (i.e., outdegree activity), a tendency for variation in residents' degree of popularity (i.e., indegree popularity), and a tendency for residents who are active in the network to also be more popular (i.e., outdegree popularity).

with someone who indicates they have a relationship with the resident than with someone who does not. This is also a common phenomenon in human relationships (Kadushin, 2012).

3. The positive outdegree activity effects mean residents who report larger numbers of alters are more likely to maintain or add additional ties, resulting in significant variation in the distribution of outdegree, or activity, in the network (Snijders et al., 2010).

These three effects were common to all of the networks; in the sections below, results specific to each of the four network types will be presented. Parameter estimates and standard errors for all estimated effects are presented in Tables 4-7.

Acquaintance network.

In spite of univariate analyses showing a moderately high level of transitivity in the acquaintance networks, transitivity was not a significant effect in network dynamics after controlling for other endogenous and behavior effects. The goodness of fit testing for the depressive symptoms model found a poor fit for the model's ability to simulate the observed distribution of depressive symptoms ($p = .049$). All other goodness of fit tests across the acquaintance network models indicated a good fit at $p > .05$. Table 4 presents details about the parameter estimates, standard errors, and statistical significance for each of the effects in the acquaintance SAOMs.

Table 4: Results—dynamics of acquaintance ties and disability-related health (*N* = 36)

	Physical Limitations			Cognitive Functioning			Depressive Symptoms		
Effect	par. est.	s.e.	sig.	par. est.	s.e.	sig.	par. est.	s.e.	sig.
Network dynamics (selection)									
basic rate parameter	21.37	-2.23	***	21.29	-2.16	***	20.95	-1.87	***
outdegree (density)	-1.63	-0.79	*	-1.79	-0.82	*	-1.78	-0.78	*
reciprocity		-0.15	**	0.40	-0.15	**	0.40	-0.18	*
transitive triplets	0.04	-0.03		0.04	-0.03		0.04	-0.03	
3-cycles	-0.06	-0.06		-0.05	-0.06		-0.06	-0.06	
indegree - popularity (sqrt)	0.03	-0.15		0.07	-0.15		0.07	-0.14	
outdegree - popularity (sqrt)	-0.01	-0.19		-0.01	-0.18		0.02	-0.20	
outdegree - activity (sqrt)	0.18	-0.09	*	0.20	-0.10	*	0.18	-0.09	*
mastery - alter	-0.02	-0.03		-0.01	-0.03		0.00	-0.04	
mastery - ego	-0.01	-0.03		-0.01	-0.03		0.01	-0.03	
behavior - alter	-0.02	-0.02		0.00	-0.03		0.00	-0.03	
behavior - ego	0.00	-0.02		-0.02	-0.02		-0.01	-0.03	
behavior - similarity	0.51	-0.38		-0.08	-0.35		0.54	-0.61	
Behaviour Dynamics (influence)									
rate	6.24	-2.38	**	4.83	-1.86	**	5.82	-3.15	†
linear shape	-0.12	-0.56		-0.22	-0.51		0.78	-0.80	
quadratic shape	-0.06	-0.04		0.03	-0.04		-0.02	-0.04	
behavior indegree	0.04	-0.06		0.03	-0.06		-0.11	-0.08	
behavior outdegree	-0.02	-0.03		-0.01	-0.04		0.03	-0.03	
average alter	0.29	-0.41		-	-		0.21	-0.42	
total alter	-	-		0.00	-0.05		-	-	
effect from mastery	0.09	-0.09		-0.10	-0.10		0.11	-0.10	
All convergence t ratios	< 0.06			< 0.06			< 0.07		
Overall maximum convergence ratio	0.21			0.19			0.20		

Note: **p* < .05; ***p* < .01; ****p* < 0001; †*p* < .10. To determine statistical significance, the parameter estimate was divided by its standard error. Absolute values > 1.96 were used for significance at *p* < .05; absolute values > 2.58 were used for significance at *p* < .01; absolute values > 3.29 were used for significance at *p* < .001; and absolute values > 1.65 indicate approaching significance at *p* < .10

Companionship network.

Significant endogenous effects on the dynamics of the companionship network included those that were significant across all four networks (i.e., outdegree (density), reciprocity, and outdegree-activity). In addition, the companionship network dynamics were significantly

related to indegree popularity—the tendency for popular residents to receive additional ties or maintain existing companionship nominations compared to less popular residents (Snijders et al., 2010). In the model that examined the co-evolution of companionships and depressive symptoms, the effect of an alter's depressive symptoms on the creation or maintenance

Table 5: Results—dynamics of companionship ties and disability-related health (*N* = 36)

	Physical Limitations			Cognitive Functioning			Depressive Symptoms		
Effect	par. est.	s.e.	sig.	par. est.	s.e.	sig.	par. est.	s.e.	sig.
Network dynamics (selection)									
basic rate parameter	6.80	-0.86	***	6.94	-0.98	***	6.94	-0.92	***
outdegree (density)	-4.65	-0.72	***	-4.60	-0.71	***	-4.35	-0.77	***
reciprocity	1.76	-0.39	***	1.78	-0.38	***	1.75	-0.38	***
transitive triplets	0.21	-0.11	†	0.21	-0.12	†	0.24	-0.11	*
3-cycles	-0.23	-0.23		-0.22	-0.24		-0.22	-0.21	
indegree - popularity (sqrt)	0.74	-0.21	***	0.75	-0.20	***	0.55	-0.24	*
outdegree - popularity (sqrt)	-0.24	-0.23		-0.27	-0.25		-0.22	-0.23	
outdegree - activity (sqrt)	0.72	-0.16	***	0.70	-0.17	***	0.71	-0.19	***
mastery - alter	0.02	-0.06		0.01	-0.06		-0.07	-0.08	
mastery - ego	-0.12	-0.09		-0.12	-0.09		-0.10	-0.11	
behavior - alter	0.01	-0.04		0.00	-0.04		0.13	-0.07	†
behavior - ego	0.04	-0.04		-0.04	-0.05		-0.05	-0.06	
behavior - similarity	-0.20	-0.81		0.13	-0.66		0.78	-0.96	
Behavior dynamics (influence)									
rate	5.47	-3.13	†	3.93	-1.78	*	7.85	-2.82	**
linear shape	0.47	-0.55		0.28	-0.30		-0.16	-0.19	
quadratic shape	-0.08	-0.07		0.04	-0.04		0.00	-0.03	
behavior indegree	-0.08	-0.13		-0.08	-0.08		-0.03	-0.06	
behavior outdegree	-0.08	-0.08		-0.02	-0.06		0.02	-0.04	
average alter	-	-		-0.16	-0.48		-	-	
total alter	-0.10	-0.13		-	-		0.01	-0.03	
effect from mastery	0.11	-0.13		-0.13	-0.13		0.05	-0.06	
All convergence t ratios	< 0.05			< 0.06			< 0.04		
Overall maximum convergence ratio	0.15			0.18			0.17		

Note: **p* < .05; ***p* < .01; ****p* < 0001; †*p* < .10. To determine statistical significance, the parameter estimate was divided by its standard error. Absolute values > 1.96 were used for significance at *p* < .05; absolute values > 2.58 were used for significance at *p* < .01; absolute values > 3.29 were used for significance at *p* < .001; and absolute values > 1.65 indicate approaching significance at *p* < .10

of network ties (Θ = .13, $p < .10$) suggests a possible tendency toward companionship ties being created or maintained with alters who had higher levels of depressive symptoms, though the effect was not significant at the α = .05 level. Goodness of fit tests indicated the models did a good job simulating the observed network and behavior ($p > .05$ across all models).

Enacted social support network.

As in all of the four types of residents' social networks, the co-evolution models in the enacted support network had significant outdegree, reciprocity, and outdegree-activity effects (see Table 6). The effect of an ego's level of cognitive functioning (behavior-ego effect) on the creation and maintenance of enacted support ties (Θ = 0.05, $p < .10$) indicates a possibility that residents with higher levels of cognitive functioning may have been more likely to begin or continue giving social support to other residents than those with lower levels, although the effect was not significant at the α = .05 level. Goodness of fit tests indicated the models did a good job simulating the observed network and behavior with $p > .05$ across all models.

Multicollinearity.

The behavior dynamics effects of behavior outdegree and behavior indegree exhibited multicollinearity in the depressive symptoms model ($r > .98$), so the effect of outdegree was removed. The logic behind this choice is that prior research has consistently shown a positive effect of giving social support (outdegree), but has inconsistent results regarding receiving support (indegree). Therefore it was deemed more salient to capture the effect of receiving enacted support on depressive symptoms than giving it.

Table 6: Results—dynamics of enacted support ties and disability-related health (*N* = 36)

	Physical Limitations			Cognitive Functioning			Depressive Symptoms		
	par. est.	s.e.	sig.	par. est.	s.e.	sig.	par. est.	s.e.	sig.
Network dynamics (selection)									
basic rate parameter	12.93	-1.51	***	12.95	-1.53	***	12.91	-1.67	***
outdegree (density)	-3.53	-0.57	***	-3.46	-0.59	***	-3.60	-0.65	***
reciprocity	1.59	-0.22	***	1.60	-0.22	***	1.58	-0.24	***
transitive triplets	0.09	-0.06		0.10	-0.07		0.09	-0.07	
3-cycles	-0.16	-0.11		-0.18	-0.13		-0.17	-0.12	
indegree - popularity (sqrt)	0.34	-0.28		0.20	-0.38		0.35	-0.29	
outdegree - popularity (sqrt)	-0.05	-0.27		0.12	-0.38		-0.04	-0.26	
outdegree - activity (sqrt)	0.32	-0.09	***	0.30	-0.09	***	0.33	-0.10	***
mastery - alter	-0.05	-0.04		-0.06	-0.05		-0.05	-0.05	
mastery - ego	-0.03	-0.04		-0.03	-0.04		-0.04	-0.06	
behavior - alter	0.00	-0.03		-0.04	-0.06		0.02	-0.04	
behavior - ego	-0.02	-0.02		0.05	-0.03	†	0.02	-0.05	
behavior - similarity	-0.02	-0.49		-0.19	-0.46		0.62	-0.65	
Behavior dynamics (influence)									
rate	6.93	-2.52	**	3.30	-1.75	†	7.33	-4.39	
linear shape	-0.04	-0.26		0.79	-1.07		-0.23	-0.32	
quadratic shape	-0.05	-0.03	†	0.02	-0.07		-0.01	-0.03	
behavior indegree	0.07	-0.08		-0.26	-0.38		0.00	-0.04	
behavior outdegree	-0.06	-0.07		0.14	-0.25		-	-	
average alter	-	-		0.32	-0.66		0.20	-0.40	
total alter	-0.01	-0.02		-	-		-	-	
effect from mastery	0.09	-0.07		-0.18	-0.22		0.08	-0.07	
All convergence t ratios	< 0.06			< 0.05			< 0.06		
Overall maximum convergence ratio	0.13			0.21			0.15		

Note: *p < .05; **p < .01; ***p < 0001; †p < .10. To determine statistical significance, the parameter estimate was divided by its standard error. Absolute values > 1.96 were used for significance at p < .05; absolute values > 2.58 were used for significance at p < .01; absolute values > 3.29 were used for significance at p < .001; and absolute values > 1.65 indicate approaching significance at p < .10

Negative interaction network.

Convergence.

Convergence was problematic in the negative interaction network, possibly as a result of the sparse data (85 ties at w1 and 65 ties at w2) or the Jaccard index of < .3 (Ripley et al.,

2017). Several adjustments to the specification of the basic co-evolution models were made to obtain results.

1. It was necessary to use the more limited effect of transitive closure rather than transitive triads on network dynamics.[11]
2. The model for negative interactions and cognitive functioning did not converge with social influence effects (neither average alter nor total alter), so neither was estimated.
3. There was multicollinearity with the effects of indegree popularity and outdegree popularity on network dynamics. Therefore, outdegree popularity was removed from the models.
4. There was multicollinearity between behavior indegree and behavior outdegree effects across all three disability-related health dependent variables. To address this, the effect of outdegree on behavior dynamics was removed from the models.

SAOM results.

Significant endogenous effects on the dynamics of the negative interactions network included those that were significant across all four networks (i.e., outdegree (density), reciprocity, and outdegree-activity). In addition, there was a significant and positive indegree-popularity effect indicating that residents with higher numbers of negative interactions directed

[11] The effect of transitive triads relates to whether or not the creation or maintenance of a tie results in any type of transitivity. Transitive closure relates only to ties that connect ego to an alter's alter and does not include the creation or maintenance of ties that connect two actors who share an alter. In other words, the stricter effect of transitive closure excludes situations in which negative interactions from one resident (A) toward another (B) result from them both acting negatively toward a third resident (C). Rather it only describes circumstances where resident A acts negatively toward resident B and resident B acts negatively toward resident C, measuring whether or not that network structure leads to resident A subsequently acting negatively toward resident C.

toward them were more likely to receive new negative interactions or maintain the ones they had than those with smaller numbers. Goodness of fit tests indicated the final models did a good job simulating the observed network and behavior ($p > .05$ across all models).

Table 7: Results—dynamics of negative interaction ties and disability-related health (*N* = 36)

	Physical Limitations			Cognitive Functioning			Depressive Symptoms		
Effect	par. est.	s.e.	sig.	par. est.	s.e.	sig.	par. est.	s.e.	sig.
Network dynamics (selection)									
basic rate parameter	15.5	-3.7	***	15.37	-3.38	***	15.54	-3.43	***
outdegree (density)	-5.3	-0.7	***	-5.23	-0.69	***	-5.34	-0.69	***
reciprocity	3.6	-0.7	***	3.43	-0.65	***	3.44	-0.59	***
transitive closure	0.6	-0.4		0.42	-0.29		0.62	-0.37	†
3-cycles	-0.7	-0.4	†	-1.01	-0.55	†	-0.78	-0.34	*
indegree - popularity (sqrt)	0.7	-0.2	***	0.74	-0.19	***	0.71	-0.20	***
outdegree - activity (sqrt)	0.4	-0.2	*	0.45	-0.15	**	0.48	-0.14	***
behavior - alter	0.0	-0.1		0.03	-0.07		0.05	-0.07	
behavior - ego	-0.1	-0.1		-0.01	-0.07		-0.01	-0.07	
behavior - similarity	-0.6	-0.8		0.42	-0.73		0.35	-0.99	
Behavior dynamics (influence)									
rate	7.7	-2.4	***	5.17	-1.81	**	5.85	-4.05	
linear shape	-0.1	-0.2		0.12	-0.16		-0.27	-0.26	
quadratic shape	0.0	0.0		0.03	-0.03		-0.01	-0.05	
behavior indegree	0.0	-0.1		-0.04	-0.05		0.02	-0.08	
average alter	0.1	-0.2		-	-		0.28	-0.54	
All convergence t ratios	<.08			<.04			<.08		
Overall maximum convergence ratio	0.16			0.12			0.18		

Note: *$p < .05$; **$p < .01$; ***$p < 0001$; †$p < .10$. To determine statistical significance, the parameter estimate was divided by its standard error. Absolute values > 1.96 were used for significance at $p < .05$; absolute values > 2.58 were used for significance at $p < .01$; absolute values > 3.29 were used for significance at $p < .001$; and absolute values > 1.65 indicate approaching significance at $p < .10$

Summary of Results

The ALF residents in this study ALF had robust social networks of acquaintances, with an average of approximately 11 acquaintances per residents. They also had fairly dense enacted social support networks across the two waves. Although residents had fewer companions among other residents (approximately two to three each), most residents reported had at least one companion. Fewer residents experienced negative interactions with their fellow residents, but this type of social tie nonetheless present within the ALF, with some residents notably more involved in negative interactions than others.

Stochastic actor-oriented models (SAOMs) for network and behavior dynamics found significant endogenous effects in the creation and maintenance of social ties among the ALF residents. Univariate analyses found no significant change in the three disability-related health factors examined in this dissertation. When controlling for network dynamics, this result held for depressive symptoms, but rate parameters for physical limitations and cognitive functioning indicated that change in these disability-related health factors did occur when accounting for residents' social network dynamics. In spite of significant homophily in cross-sectional analyses, no significant effects of social influence or social selection were found to explain network or behavior dynamics in the three month course of the study. Results and their implications are discussed in further detail in Chapter 5.

Chapter 5: Discussion

This dissertation provides insight into the structure of social networks among residents of an assisted living facility (ALF) considering four types of relationships (acquaintances, companionships, enacted social support, and negative interactions) and examines the dynamics of residents' disability-related health and their social networks. The aging of the Baby Boomer generation and increasing lifespans usher in an increased need for long-term services and supports such as ALFs for older adults who are no longer able to perform activities of daily living or instrumental activities of daily living without assistance (Hagen, 2013). In spite of the growing importance of ALFs for older adults, little is known about an important and potentially salubrious aspect of life in an ALF—residents' social networks. This chapter discusses the dissertation's findings, identifies its strengths and limitations, and proposes implications for research, theory, practice, and policy.

The Structure of Residents' Social Networks

The dissertation's first research question addresses the structure of the residents' social networks because little is known about the numbers and configurations of social relationships between residents in ALFs. As in other studies (Kemp et al., 2012; Kemp et al., 2016; Sefcik & Abbott, 2014), this research found that acquintances, companionships, enacted social support, and negative interactions existed among ALF residents. By assessing all four types of these types of social ties within the same group of people, this study enables a direct comparison of the number of social ties and stability of the four types of social networks. Older adults' social networks have not received the same attention as those of younger adults and adolescents (Cornwell & Schafer, 2016), so the descriptive findings about the number of ties, local structural

characteristics (i.e., reciprocity and transitivity), and homophily in the four networks add to a basic understanding of older adults' social networks.

Number of ties.

The most fundamental descriptive finding is that, in spite of their physical limitations, residents had substantial numbers of social ties with one another. The most commonly reported type of social tie was acquaintance; on average, participants had 10.8 acquaintances at wave 1 and 11.2 at wave 2. Considering that the study operationalized "acquaintance" as someone with whom the resident had interacted with more than just greeting (i.e., had conversed with in the previous three months), the high number of acquaintances is striking. The field notes for the dissertation research indicated that participants reported knowing and acknowledging additional residents who did not meet the study's definition of an acquaintance. Previous research has found that some older adults appreciate a social environment where others are in proximity even if they are not interacting with them (Greenfield & Mauldin, 2016), so the ALF may have had an even more nurturing social environment than the sheer number of acquaintances suggest.

The second most common type of relationship was enacted social support, which was operationalized as a relational event (e.g., listened to, helped) (Borgatti et al., 2013) in which one or more transactions of social support had occurred in the previous three months. Participants gave support to or received support from an average of 7.1 other participants at wave 1 and 6.3 other participants at wave 2, with the vast majority of participants (> 90%) involved in the support transactions. This relatively large number of enacted support ties occurred in spite of some residents feeling they were unable to provide help because of their

physical limitations or because the ALF did not allow residents to help one another, as evidenced by interview notes.[12] Enacted support was not confined to companionships, but took place between acquaintances as well. This supports the proposition that weak ties can be a conduit for social resources and deserve further study (Fingerman, 2009).

The numbers of companion ties reported in the ALF were in line with previous research on closer relationships. The network of residents' companionships consisted of an average of 2.7 companions per resident at wave 1, similar to the number of confidants (2.24) that Schafer (2011) found among residents of an independent living community. Confidants are not the same as companions, but they are a more intimate type of relationship than weak ties such as acquaintances. These results show that ALF residents may be able to maintain numbers of closer ties similar to those of their higher functioning counterparts in independent living. It is understandable that there are fewer companionship ties than acquaintances, as companionships are a more intimate type of relationship requiring more time and energy than acquaintances (Fingerman, 2009).

The rarest type of relationship among the ALF residents was negative interactions. Prior research has found that negative interactions are less common than positive interactions (Rook, 2014), so this finding was not surprising. It is important to note that the positivity effect—older adults tend to pay more attention to positive content than negative content compared to younger people (Reed & Carstensen, 2012)—had the potential to dampen reporting of negative interactions. In spite of this potential reporting bias, a majority of residents in the study's

[12] Information regarding the ALF's policies about residents helping one another was not obtained directly from the ALF.

sample (83.3% at w1 and 69.4% at wave 2) had experienced negative interactions in the previous three months, suggesting that negative interactions are a reality of life in an ALF.

Reciprocity and transitivity.

One reason this dissertation quantified reciprocity and transitivity in the networks is that there is limited research on the structure of older adults' social networks, which could be different from the social networks of younger adults and adolescents (Cornwell & Schafer, 2016). This dissertation's findings mostly mirror those in the broader extant literature on social networks, yet they advance the knowledge of the structure of the social networks of older adults, particularly those in residential facilities.

There were moderate levels of reciprocity—a common trait of human social networks (Kadushin, 2012)—in the acquaintance and companionship networks. It is somewhat unexpected that the percent of reciprocated ties at wave 1 in the companionship network (36%) was not higher than those in the acquaintance network (46%) since more intimate types of relationships are more likely to be reciprocal (Granovetter, 1973). This could have arisen because of the common blurring of the distinctions between the two types of ties (Fingerman 2009). For example, one resident could have categorized the relationship as a weak companionship while the alter categorized it as a strong acquaintance, thus reducing number of reciprocated ties. By wave 2, the levels of reciprocity in both networks were the same (40%). It is important to recognize that the enacted support and negative interactions networks were constructed by combining two complementary networks—the interactions received with those given—which likely resulted in higher levels of reciprocity. As a result, the enacted support and

negative interactions networks should not be directly compared to the acquaintance and companionship networks.

Levels of transitivity in the acquaintance and companionship networks were high in the cross-sectional descriptive analyses, suggesting that being acquainted with the acquaintances of one's acquaintances or having a companionship with the companions of one's companions were common. Like the findings for reciprocity, the transitivity findings are in alignment with research in other settings which show transitivity is common in the networks of younger adults and adolescents (Kadushin, 2012).

Homophily.

Very few studies—perhaps only one (Schafer, 2011, 2015, 2016)—have examined homophily on health status among older adults. The findings from this dissertation research help build knowledge about whether older adults are more likely to have relationships with others with similar health. In three of the four networks in this dissertation, some type of disability-related health homophily was found in cross-sectional descriptive analyses. For example, acquaintances at wave 2 were more likely to occur between residents with similar levels of physical functioning. Depressive symptom homophily was present in the companionship and negative interaction networks. Schafer (2016) found what he called "status-oriented homophily" (p. 85) on health (i.e, homophily among those in the 1st and 4th quartiles of health, but not in the middle) among residents of an independent living community. He suggested that health is a type of hierarchical status in which older adults aspire to interact with people who have higher levels of health, giving those with the best health the opportunity to select each other and leaving those at the lowest levels to interact with each other. Further

research could examine whether this type of status-oriented homophily was exhibited for physical limitations, cognitive functioning, and depressive symptoms among the ALF residents.

Network Dynamics.

Beyond providing cross-sectional descriptions of the social networks in the ALF, this dissertation research examined the dynamics of the networks and found each of the networks changed over the course of three months. Network change in later life in inevitable (Wrzus et al., 2013) and can have beneficial or adverse effects depending on the circumstances behind the change (Cornwell, 2015). Substantial numbers of ties were added or dropped in each of the networks in this study between wave 1 and wave 2, yet further research is needed to fully understand the levels of stability in the networks and their effects.

For example, the change in the acquaintance and companionship networks (Jaccard indices of .382 and .349 respectively) could have resulted from acquaintance ties developing into companionships, as found in previous research (Van Duijn, et al., 2003). Indeed, most of the change in the companionship network (86 of the 112 tie changes, 76.8%) resulted from ties being added rather than being dropped. Intimate relationships like those in the companionship network tend to be more stable over time than relationships that are more casual (Fingerman, 2009; Wrzus et al, 2013), so it is unexpected that the companionship network was slightly less stable than the acquaintance network. The possibility that acquaintances turned into companionships might explain this finding.

The negative interaction network was not particularly stable (Jaccard index = .210), with most of the instability coming from ties that were dropped between wave 1 and wave 2 (n = 59, or 60% of the changed ties). This could reflect events in the ALF that resulted in fewer negative

interactions among participants. It could also be explained by circumstances that introduced a greater positivity bias (Kennedy, Mather, & Carstensen, 2004) at wave 2. For example, wave 2 occurred during the holiday season and this timing may have had an effect on participants' perceptions of negative interactions. It is also conceivable that participants discussed the survey with one another after the first wave of data collection and developed a norm against reporting negative interactions. Contrary to the findings of this dissertation, several studies have found that older adults have persistent negative interactions with network members, even up to six years follow-up (Krause & Rook, 2003). Additional longitudinal SNA research with more waves of data collection over a longer duration of time could better illuminate the nature of the duration and stability of negative interactions among ALF residents.

Endogenous effects on network dynamics.

The structural, or endogenous, effects (e.g., reciprocity—the propensity to return a social tie) that were significantly involved in the creation and maintenance of social ties in the ALF are effects that are common in human relationships (Lusher et al., 2013). For instance, in all four of the social networks, there was a significant and negative outdegree (density) effect, a significant and positive effect for reciprocity, and a significant and positive outdegree - activity effect. This indicates that, after controlling for the other effects, there was a tendency away from forming ties, toward creating or maintaining ties that would result in reciprocal relationships, and toward ties being created or maintained by residents who already had high numbers of outgoing ties. These findings contribute to the literature because they show that these social mechanisms are at play in networks of older adults as well as younger adults and

adolescents who have tended to be the focus of whole social network analysis in previous research (Cornwell & Schafer, 2016).

There are some specific endogenous effects that are noteworthy in the four networks. Transitivity (i.e., the friend-of-a-friend effect) was not a significant factor in the creation or formation of many of the ties in this study. For example, acquaintances were not created or maintained through other acquaintances. Although transitivity is not ubiquitous in human networks, it is a common mechanism for social connections to be formed (Snijders et al., 2010), particularly in less intimate relationship types (Van de Bunt et al., 1999; Van Duijn et al., 2003). At the research site, there were many opportunities for social interaction through common areas, shared meals, and group activities. The residents' social networks could be considered to have low network elasticity (Lazer, 2001) because there are limited choices with whom to interact. Paired with the socialization opportunities, the low network elasticity may have attenuated the need for transitivity as a mechanism for selection of social partners.

One of the networks in which transitivity was significant was the companionship network. In it, transitivity was a significant factor in the creation and maintenance of relationships when accounting for depressive symptoms, but not when controlling for physical limitations or cognitive functioning. Perhaps the environmental and social supports of the ALF worked better for people with physical and cognitive impairments than they did for people with depressive symptoms, making transitivity more salient. It is conceivable that across varying social environments, older adults with higher levels of depressive symptoms rely on their close companions to make and maintain friends compared to those with low levels of depressive symptoms. Additional research is needed to better understand this phenomenon. It is

important to note that in this study, residents with higher levels of depressive symptoms were just as likely to form social ties as those with lower levels of depressive symptoms, so this difference did not result in less social integration for the residents. It merely suggests a different mechanism was involved in creating and maintaining companionships when considering depressive symptoms compared to physical and cognitive functioning.

In both the companionship and negative interaction networks, there was a significant indegree (i.e., ties received) popularity parameter. In the companionship network, this can be seen as an effect where the rich get richer in receiving ties (Snijders et al., 2010). This was not because socially active residents were more popular (i.e., the outdegree [sending ties] - popularity effect was non-significant). Of course, the dark side of this effect plays out in the negative interaction where residents who are already on the receiving end of many negative interactions are more likely to maintain or receive additional negative interactions. Additional analyses can be conducted to determine what factors are associated with residents' popularity in these networks.

Co-evolution of Networks and Disability-related Health.

Of particular interest to this dissertation was the way in which disability-related health and social networks co-evolved for ALF residents. Over the course of the three months between wave 1 and wave 2, there was no evidence supporting the hypothesized co-evolution of relationships and health. Indeed, preliminary analyses found no significant change in residents' disability-related health even before considering network dynamics. Timing the waves of data collection for this dissertation research was challenging because there were no examples of previous longitudinal SNAs in ALFs to guide the research design. If too much time

between the waves elapsed, the turnover in the ALF could preclude using stochastic actor-oriented models (SAOMs) for analyses due to violation of the assumption of gradually changing networks. However, if too little time elapsed, there was the risk of not having enough change in disability-related health outcomes. Although this was the case in this dissertation research, the findings are nonetheless helpful because they provide information about the levels of ALF residents' disability-related health and trajectories of change in them over the course of three months.

The cross-sectional descriptive network statistics show homophily along depressive symptoms in the companionship and negative interaction networks and for physical limitations in the acquaintance network. However, in the longitudinal analyses, there was no evidence for social selection or social influence in the creation or maintenance of residents' social ties. This suggests that other factors such as the tendency to reciprocate social ties or make social connections through pre-existing social ties may explain the homophily in those networks. Another consideration is that the SAOMs specifically modeled the creation of new social ties or maintenance of pre-existing ties over the course of three months. With two waves of data, the SAOMs could not model network dynamics for people who moved into the ALF after wave 1 because the baseline data did not include them. As a result, the analyses did not include many residents who were new to the ALF and in the beginning stages of forming relationships with other residents. In fact, the average length of stay in the ALF among the study's participants was approximately two years. It is reasonable to imagine that the mechanisms of social influence and social selection mechanisms had played out in the months and years prior to the study initiation more strongly than in the course of the study.

Strengths and Limitations

This dissertation addresses gaps in our knowledge of older adults' social networks using an innovative approach of longitudinal whole social network analysis (SNA). Social gerontologists have called for the use of whole SNA to understand how the structure of the social networks of older adults compare to that of the social networks of other populations (Cornwell & Schafer, 2016). By employing this method, this dissertation provided new information about the size, structure, and dynamics of the social networks of ALF residents.

The breadth of the inquiry, which included four types of social relationships and three types of disability-related heath factors, allowed for comparisons of older adults' social ties and of effects across a range of twelve different co-evolution models. Acquaintances, companionships, enacted social support, and negative interactions are all important for older adults' health (Krause, 2006), yet few, if any studies have examined all four types of relationships among the same group of older adults. Physical limitations, cognitive functioning, and depression are associated with levels of older adults' disability and with their social integration. By examining the dynamics of each of the twelve combinations of disability-related health and social networks, this dissertation provided insights over a broad range of influences on older adults' wellbeing.

Another strength of this research is its longitudinal exploration of the reciprocal effects of social networks and health. Most of the extant literature on older adults' health and social integration is cross-sectional, which precludes analyzing the reciprocal effects of health and social networks. This dissertation provides a foundation for future longitudinal research of

longer duration to provide additional insights into the dynamics of health and social networks of older adults.

There are limitations that should be acknowledged when interpreting the results. The research was conducted in only one ALF, making it impossible to generalize findings, especially given the heterogeneity of ALFs in the United States (Sengupta, Lendon, & Harris-Kojetin, 2017). The sample for the research was predominantly non-Hispanic White and highly educated. The lack of racial and ethnic diversity is a characteristic of ALFs in general. In 2014 in the State of Texas, 11% of ALF residents belonged to racial or ethnic minority groups (Sengupta, Harris-Kojetin, & Caffrey, 2015a) and nationally, 15% did (Sengupta, Harris-Kojetin, & Caffrey, 2015b).

Almost 40% of the residents screened for the study were ineligible based on the cognitive screening. This resulted in a small sample (N = 36) with limited power to detect changes in the disability-related health dependent variables (Snijders, et al., 2007). Because residents had to pass the cognitive screener to participate, the relationships and health of residents with dementia or mild cognitive impairment were not assessed. It is important to recognize that the descriptions of the social networks in this dissertation apply to the social networks of residents who do not have cognitive impairment, rather than the entire facility. Based on the field notes, it is likely this eligibility criterion may have led to fewer isolates being reported in some of the networks (e.g., the companionship network), but also to a reduction in the number of alters nominated by residents who had relationships with residents who were ineligible to participate in the study.

Implications

In spite of these limitations, this dissertation research adds to the knowledge of social relationships and health among older adults in an ALF and provides insights for future research, theory, practice, and policy.

Implications for research.

The analyses for this dissertation provide results for a broad understanding of network and health dynamics in the ALF by exploring twelve combinations of four types of relationships and three types of disability-related health. The breadth of the examination is a strength of this study, yet opportunities remain for deeper analyses to explore additional important research questions.

Understanding the nature of the residents who were not connected to others in the network (i.e., isolates) could help develop interventions for social isolation in ALFs. For example, it is important to identify factors that are associated with social isolation in an ALF. It is also valuable to determine the levels of loneliness—or alternately, contentment with social circumstances—among isolates in ALFs, because they may not desire more social integration. Isolates may have robust social networks outside the ALF and may not rely on other residents for social integration. Additional research and analyses of the dissertation's data could investigate these issues. Future research should consider relationships and interactions with people not living in the ALF when examining isolates.

Additional analyses should also give more scrutiny to the four types of relationship ties. This dissertation operationalized enacted support as a composite of informational, tangible, and emotional support. It may be fruitful to decompose this construct into the three types of

support to investigate their effects separately. Likewise, the four components of the negative interaction network can be analyzed separately to better understand how they influence the ALF's social environment. Determining whether specific types of negative interactions affect attendance at group activities or influence the other social networks are important questions to consider. The findings could help address the "burning issue [in ALFs]...around the rights of the individual versus the rights of the larger group" (K. B. Wilson, 2007, p. 20), as many of the negative interactions reported in this study could be viewed from the perspective of individual freedoms versus group needs. For instance, residents' behaviors about where they parked their wheelchairs or how they handled their pets were viewed as thoughtless or insensitive behavior by some participants, but could be considered an expression of individualism or the right to equal access to common areas by the residents in question.

Understanding network dynamics without modeling behavior dynamics is also an important avenue for future analyses. Stochastic actor-oriented models for network dynamics can be specified to explore a variety of effects such as residents' co-attendance at group activities, proximity of residents' apartments to each other, homophily on dimensions such as age and gender, and various individual-level attributes.

Another promising area of inquiry involves multiplexity, the state of multiple types of social ties between two people (Kadushin, 2012). The data for this dissertation provide the opportunity to explore multiplex relationships such as enacted support and negative interactions or to distinguish the effects of support given by friends from support given by acquaintances. Similarly, one type of tie could be used as a covariate which could predict the network dynamics in another network. Research questions along this line of inquiry include (1)

do acquaintances lead to the creation of companionship ties? or (2) *do companionship or acquaintance ties more strongly influence the provision of enacted support*?

The findings of this dissertation point to the need for longitudinal research that lasts for longer than three months to capture greater changes in residents' disability-related health. Such research would need to have several waves with relatively short periods of time between the waves (e.g., every two to three months) to ensure gradual network change. To truly understand how social networks and well-being co-evolve in ALFs, this research should be conducted in a variety of facilities. Including diverse older adults, particularly along racial, ethnic, and socioeconomic dimensions, is important. Although working with participants who have cognitive impairment poses research challenges, they are an integral part of ALFs and should be included in future research. A pilot feasibility SNA study has been conducted on ALF residents with dementia and offers suggestions such as simplified interviews and photographs on rosters to make this possible (Abbott et al., 2015). Second, it is important to examine different types of ALFs. It is possible that ALFs that receive Medicaid funding may have different social environments than those that do not. Size, architecture, and geographic locations may also influence results.

Implications for theory.

This study draws on the social competence/breakdown theory of aging to propose a model for understanding an association of residents' competence (i.e., mastery), social networks, and disability-related health. The findings of this research do not provide evidence for the role of mastery in the co-evolution of social networks and health. Specifically, levels of mastery were not significant predictors of change in relationship ties or disability-related health

in any of the twelve models of this dissertation. Research with larger samples or with longer timeframes for longitudinal assessment is needed to understand if this is a result of the study's limitations or a failure of the social competence/breakdown theory of aging to predict outcomes among older adults in an ALF. If the findings are replicated in future research, two specific areas of inquiry warrant further exploration. First, the role of competence as a mediator of social relationships and disability-related health should be reexamined in the theory; perhaps competence is not a mechanism through which age-related losses and dependency are connected. Second, the cultural environment of an ALF should be considered when applying the social competence/breakdown theory of aging. A key premise in the theory is that society does not provide age-appropriate norms for older adults (Kuypers & Bengtson, 1973). However, ALFs have norms and reference groups different from those of society as a whole (Doyle, de Medeiros, & Saunders, 2012) which may attenuate the theorized erosion of competence for older adults after age-related losses.

Findings also reflect upon other theories of social gerontology. For instance, the residents' robust acquaintance and companionship social networks belie the premise of the controversial disengagement theory—that many older adults withdraw from social involvement as a normal process of aging (Cumming & Henry, 1961). Decades of research have failed to empirically support disengagement theory, yet traces of it still inform social gerontology today (Bengtson, 2016). In contrast, continuity theory posits that older adults seek to maintain structures from their earlier life, but that individuals with impaired functioning are unable to do so (Atchley, 1989). The findings from this research do not support the premise that older adults with limitations are unable to have robust social networks. The aging-related theory that is

perhaps most supported by this research is the model of selective optimization with compensation, which acknowledges that older adults may have difficulty maintaining previous social structures, but can make adaptations in areas that are important to them in order to overcome these difficulties (Baltes & Baltes, 1990). The environmental and social supports of an ALF may be such an adaptation as evidenced by the high numbers of social connections within the ALF in this research.

Implications for practice.

As ALFs gain importance in the landscape of long-term services and supports (LTSS) for older Americans, improving residents' health and supporting their social integration can decrease social costs associated with LTSS and increase individual well-being. On the most fundamental level, this research suggests that ALFs themselves are an effective intervention to support the social integration of older adults who have lost some of their independence. Other practice implications concern residents' emotional needs and negative interactions.

In the four month period between the start of recruitment and enrollment (which lasted three weeks) through data collection at wave 1 and wave 2, almost 1/5 of the originally enrolled participants had moved out of the ALF or passed away. To the extent that other ALFs experience similar levels of attrition, residents live with the reality of constantly changing social networks. During the interviews conducted for this dissertation research, some participants expressed grief at the death of other residents, mentioned they preferred not to form relationships because they were too fleeting in the ALF, or were unsure whether or not residents who were in the hospital or rehab were ever returning. Such losses to social networks can be adverse events with harmful effects (Cornwell, 2015). ALF administrators

should recognize this concern and provide supports to residents such as on-site social workers or support groups for residents to process their social losses.

In a similar vein, ALF staff may need to find effective social interventions for residents with elevated depressive symptoms. As previously reported, transitivity played a significant role in the dynamics of companionship when controlling for depressive symptoms, but not physical limitations or cognitive functioning. This could be explained by the fact that the facility offered a variety of supports for residents with physical limitations ranging from providing activities that did not require physical exertion to having assistants wheel residents to activities, even when the resident may have forgotten the activity was happening. These supports may have allowed people with physical or cognitive impairments to form and maintain companionships without relying on other companions to help with the connections. In the activity-rich setting of an ALF, behavioral activation (Lewinsohn, Biglan, & Zeiss, 1976) may not only address residents' depressive symptoms but also enhance their social integration. Behavioral activation treatment for depression entails consciously participating in pleasant activities and tracking daily moods and attendance and has been found to be as effective as cognitive therapy in reducing depression (Cuijpers, van Straten, & Warmerdam, 2007). Additional research can explore what supports are effective in ALFs for residents with elevated depressive symptoms and how they influence residents' social integration.

Finally, the findings show that negative interactions were not uniformly distributed in the network. There were residents who were more likely to perpetuate the negative interactions as well as those who were more likely to be on the receiving end of the experience. This suggests that interventions should be a targeted rather than a general approach. There is

limited research on negative interactions in residential care or interventions to address it, however the strategy of targeted interventions is in alignment with recommendations from the National Center for Assisted (2017) for addressing bullying in ALFs.

Implications for policy.

Policymakers should recognize that the provision of LTSSs in ALFs may have the added benefit of supporting residents' social integration. The effects of social integration may be difficult to quantify financially, but it is known that social isolation carries the same magnitude of risk to mortality as smoking, substance abuse, or obesity, which all have high social costs (Holt-Lunstad et al., 2010; House, 2001). When performing cost-benefit analyses of LTSS in an ALF, the reduction of this risk should be considered.

It is beyond the scope of this research to determine if ALFs are more conducive to social integration than other models of LTSS care. However, the findings of substantial numbers of acquaintances and companions among the residents suggest that it is a beneficial environment. As such, it is a social justice issue that people with limited financial resources may not be able to access this environment. This could be addressed through universal Medicaid coverage for care in an ALF and incentives for facilities to accept Medicaid. Currently, Medicare does not cover LTSS, but beginning in 2019, Medicare Advantage plans will be allowed to offer coverage for certain types of daily maintenance care (Centers for Medicare and Medicaid Services, 2018). Industry leaders herald this policy change as a potential boon to assisted living (Mullaney, 2018). Indeed, this new policy may increase access to assisted living facilities, but it may have an unintended consequence of forcing Medicare beneficiaries to choose between their preferred living situation and preferred medical providers. Public or private funding to help

younger adults purchase long-term care insurance could also bring more equitable access to care in an ALF. Policy changes to remove or reduce structural barriers to accessing beneficial social environments in residential LTSS care are an important means of addressing this social justice concern.

Conclusion

This study examined the dynamics of social networks and health over the course of three months in an assisted living facility (ALF) in Houston, Texas. The findings provide new information about the structure of residents' social networks along four dimensions—acquaintances, companionships, enacted social support, and negative interactions. Each of the four relationship types were found in the ALF, with residents having substantial numbers of beneficial relationship ties with each other. No evidence for reciprocal effects of networks and health was found; nor was there evidence for homophily on disability-related health as a mechanism in the creation or maintenance of social ties. Interventions within an ALF to buffer the shock to social networks that occur when residents move out or pass away and to provide supports for residents with elevated depressive symptoms to directly connect with companions (as opposed to connecting through other companions) may support the positive social integration of residents. Strategically targeting negative interactions among specific residents is also indicated. LTSS policies need to consider social integration as a potential benefit of ALFs and seek ways to provide equitable access to care in ALFs.

Glossary of Acronyms

ADLs	Activities of daily living
ALF	Assisted living facility
IADLs	Instrumental activities of daily living
LTSS	Long term services and supports
NASW	National Association of Social Workers
RQ	Research question
SAOM	Stochastic actor-oriented model
SNA	Social network analysis

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Current Curriculum Vita

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EDUCATION

2018 Doctor of Philosophy
Graduate College of Social Work
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Dissertation: "The Dynamics of Social Networks and Health in an Assisted Living Facility"

2014 Master of Social Work
Graduate College of Social Work
UNIVERSITY OF HOUSTON, Houston, Texas

1988 Bachelor of Arts, Political Science
UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL, Chapel Hill, North Carolina
Graduated with Distinction

RESEARCH INTERESTS

Social gerontology; social networks, generosity, and social support in relation to physical and mental health; assisted living facilities and residents

TEACHING INTERESTS

Courses across a BSW/MSW curriculum such as research methods and theories of human behavior in the social environment; issues in aging; theories and methods of social network analysis

PUBLICATIONS

Articles in Refereed Journals

1. **Mauldin, R. L.,** Narendorf, S. C., & Mollhagen, A. (2017). Relationships among diverse peers in a cohort-based MSW program: A social network analysis. *Journal of Social Work Education*, 1-15. doi: 10.1080/10437797.2017.1284628

2. Sampson, M., Duron, J. F., **Mauldin, R. L.**, Kao, D., & Davidson, M. (2017). Postpartum depression, risk factors, and child's home environment among mothers in a home visiting program. *Journal of Child and Family Studies*, 1-10. doi: 10.1007/s10826-017-0783-8

3. Greenfield, E. & **Mauldin, R. L.** (2016). Participation in community activities through NORC Supportive Service Programs. *Ageing & Society*. Published online: 30 August 2016. doi: 10.1017/S0144686X16000702

4. **Mauldin, R. L.** (2015). Local currency for community development: Policy barriers and support. *Journal of Community Practice, 23*, 462-476. doi: 10.1080/10705422.2015. 1091420

5. Kao, D., Torres, L. R., Guerrero, E. G., **Mauldin, R. L**., & Bordnick, P. S. (2013). Spatial accessibility of drug treatment facilities and the effects on locus of control, drug use, and service use among heroin-injecting Mexican American men. *International Journal of Drug Policy*, *25*, 598-607. doi: 10.1016/j.drugpo.2013.12.012

Other Publications

1. **Mauldin, R. L.** (2017). Editorial—Social work values in Perspectives on Social Work. *Perspectives on Social Work, 13*(1), 2.

2. **Mauldin, R. L.** (2016). Editorial—Perspectives on Social Work: A community affair. *Perspectives on Social Work, 12*(2), 2.

Manuscripts in Preparation

1. Miyawaki, C. E., **Mauldin, R. L**., & Carman, C. R. (In preparation). Optometrists' referrals to community-based exercise programs: Finding from a mixed-methods feasibility study. Target journal: *Social Work.*

2. Sampson, M., **Mauldin, R. L.,** & Yu, M. (Under review). Feasibility of a problem solving tools intervention for postpartum depression among women in residential substance abuse treatment. Target journal: *Research on Social Work Practice.*

3. Yu, M., Sampson, M, & **Mauldin, R. L**. (In preparation). Early life trauma, self-efficacy, and postpartum depression symptoms. Target journal: *Archives of Women's Mental Health*.

RESEARCH FUNDING

2017-2018 National Science Foundation. Sociology Program Dissertation Improvement Grant Award #: 1702643. "*Dissertation Research: Social support and physical and cognitive functioning of older adults in assisted living facilities."* Role: Co-Principal Investigator. Principal Investigator: Sarah Narendorf, University of Houston. $12,000.

2016 National Institute on Aging. F31AG055227. *"Social Relationships and Functioning in Assisted Living: A Longitudinal Social Network Analysis."* Role: Principal Investigator. Sponsor: Kayo Fujimoto, University of Texas Health Science Center at Houston. Co-sponsor: Kyriakos Markides, University of Texas Medical Branch. Unfunded.

2014-2017 University of Houston Graduate College of Social Work. Zuñiga y Rivero Doctoral Fellowship in Gerontological Social Work. Role: Fellow. $30,000.

2016-2017, 2013-2014 University of Houston Graduate College of Social Work. Mark Magaziner Research Fellowship. Role: Fellow. $5,650.

OTHER FUNDING

2017 University of Houston Graduate College of Social Work PhD Student Travel Award. $1,000.

2017 University of Houston Drug Abuse Research Development Program II, R24DA019798. Travel Award. $900.

2016 University of Houston Graduate College of Social Work PhD Student Travel Award. $1,000.

2015-2016 University of Houston, Teaching Innovation Program Grant. *"Web-based teaching improvement project"* Role: Lead Teaching Fellow. PI: Monit Cheung, University of Houston. $1,500.

2014-2015 University of Houston, Teaching Innovation Program Grant. *"Developing, Delivering, and Disseminating the GCSW's Evidence-Based Self-Development Curriculum."* Role: Teaching Fellow. PI: Monit Cheung, University of Houston. $1,000.

2012-2014 University of Houston Graduate College of Social Work, Presidential Graduate Matching Fellowship. Role: Fellow. $5,000.

2012-2014 University of Houston Graduate College of Social Work, Dean's Advisory Council Scholarship. $5,000.

2012-2013 University of Houston Women's Gender & Sexuality Program, Patricia A. Eichhorn Endowed Scholarship for Returning Students. $250.

RESEARCH ACTIVITIES

2018-pres Co-Investigator
AGESW Pre-Dissertation Program Evaluation and Network Analysis
Principal Investigator: Nancy Kusmaul, University of Maryland, Baltimore County

2017-pres Principal Investigator
The Dynamics of Social Networks and Health in an Assisted Living Facility
DISSERTATION RESEARCH, UNIVERSITY OF HOUSTON, Houston, Texas
Funded by: National Science Foundation Award #1702643

2016-pres Research Assistant
School of Public Health
UNIVERSITY OF TEXAS HEALTH SCIENCE CENTER AT HOUSTON, Houston, Texas
Funded by: National Institute of Mental Health (R01MH100021); Gilead Sciences, Inc.

2015-pres Principal Investigator
Social Experiences in Assisted Living

2015 Visiting Professional
School of Public Health
UNIVERSITY OF TEXAS HEALTH SCIENCE CENTER AT HOUSTON, Houston, Texas
Young Men's Affiliation Project of HIV Risk and Prevention Venues

2014-2016 Principal Investigator
MSW Cohort Social Network Analysis

2014-2015 Co-Investigator
Examining Older Adults' Relationships in NORC Programs
Principal Investigator: Emily Greenfield, Rutgers University

2013-pres Research Assistant
Graduate College of Social Work
UNIVERSITY OF HOUSTON, Houston, Texas
Funded by: W.K. Kellogg Foundation, Hogg Foundation, Hartford Faculty Scholars Program

ADVANCED STATISTICS AND RESEARCH TRAINING

2017 Stochastic Models
2017 LINKS Center Summer Workshop on Social Network Analysis
UNIVERSITY OF KENTUCKY, Lexington, Kentucky
4-day workshop presented by Filip Agneesens, PhD

2015 Advanced Social Network Analysis
2015 LINKS Center Summer Workshop on Social Network Analysis
UNIVERSITY OF KENTUCKY, Lexington, Kentucky
4-day workshop presented by Steve Borgatti, PhD

2015 Social Network and Education
2015 LINKS Center Summer Workshop on Social Network Analysis
UNIVERSITY OF KENTUCKY, Lexington, Kentucky
1-day workshop presented by Alan Daly, PhD and Joe Ferrare, PhD

2015 Hierarchical Linear Modeling
2015 University of Texas Summer Statistics Institute
UNIVERSITY OF TEXAS, Austin, Texas
4-day workshop presented by Keenan Pituch, PhD

2015 Data Analysis Using SAS
2015 University of Texas Summer Statistics Institute
UNIVERSITY OF TEXAS, Austin, Texas
4-day workshop presented by Matt Hersh, PhD

2014 Analyzing Network Data
2014 LINKS Center Summer Workshop on Social Network Analysis
UNIVERSITY OF KENTUCKY, Lexington, Kentucky
4-day workshop presented by Rich DeJordy, PhD

2014 Networks and Health Applications
2014 LINKS Center Summer Workshop on Social Network Analysis
UNIVERSITY OF KENTUCKY, Lexington, Kentucky
1-day workshop presented by Tom Valente, PhD

PRESENTATIONS

1. **Mauldin, R. L.,** Avellaneda, F., Maynard, Q. R., Joseph, A. J., Minott, K., & Jennings, S. W. (accepted, October 2017). *Doctoral education: Professional socialization through participation with academic journals*. [Refereed]. Panel presentation at the 63rd Annual Program Meeting of the Council on Social Work Education: Dallas, Texas.

2. Cohen-Callow, A., **Mauldin, R. L.**, & Imboden, R. (accepted, October 2017). *Curriculum Mapping: Unique strategies for collecting, visualizing, and analyzing data*. [Refereed]. Oral presentation at the 63rd Annual Program Meeting of the Council on Social Work Education: Dallas, Texas.

3. Barros Lane, L. & **Mauldin, R. L.** (December 2016). *A mixed method investigation of the development of student relationships in a cohort-based MSW program*. [Refereed]. Paper presented at the 2016 University of Houston Social Work Research Conference: Houston, Texas.

4. Yu, M., Sampson, M., & **Mauldin, R. L.** (December 2016). *Pilot Study to Reduce Postpartum Depression Symptoms among Low-Income Mothers in a Residential Treatment Facility*. [Refereed]. Poster presented at the 2016 University of Houston Social Work Research Conference: Houston, Texas.

5. **Mauldin, R. L**., Barros-Lane, L., & Narendorf, S.C. (November 2016). *The evolution of student relationships over time in a cohort-based MSW program.* [Refereed]. Oral paper presentation at the 62nd Annual Program Meeting of the Council on Social Work Education: Atlanta, Georgia.

6. Zhou, S., **Mauldin, R. L.**, Nguyen, P.V., & Bronson, D. (November 2016). *MSW curriculum mapping with the 2015 EPAS: Methods, successes and challenges*. [Refereed]. Panel presentation at the 62nd Annual Program Meeting of the Council on Social Work Education: Atlanta, Georgia.

7. Reynolds, A. & **Mauldin, R. L.** (January 2016). *Approaching research with social network analysis perspectives and tools.* [Refereed]. Workshop presented at the Society for Social Work and Research 20th Annual Conference: Washington, DC.

8. Kao, D., **Mauldin, R. L**., & Applewhite, S. (January 2016). *Exploring the activity spaces and healthcare utilization of aging African Americans and Hispanics in Houston, Texas: A geoethnographic approach.* [Refereed]. Paper presented at the Society for Social Work and Research 20th Annual Conference: Washington, DC.

9. **Mauldin, R. L**. & Greenfield, E. (December 2015). *Participation in community activities through NORC Supportive Service Programs: Perspectives of older adults*. [Refereed]. Paper presented at the 2015 University of Houston Social Work Research Conference: Houston, Texas.

10. **Mauldin, R. L**., & Greenfield, E. (November 2015). *Neighborhood social connectedness: The influence of NORC programs.* [Refereed]. Symposium paper presented at the 2015 Gerontological Society of America Annual Scientific Meeting: Orlando, Florida.

11. Kao, D., **Mauldin, R. L.**, & Applewhite, S. (November 2015). *Exploring the activity spaces and health access of aging African Americans and Hispanics.* [Refereed]. Symposium paper presented at the 2015 Gerontological Society of America Annual Scientific Meeting: Orlando, Florida.

12. Greenfield, E. & **Mauldin, R**. **L.** (November 2015). *Fostering community connections in later life: Perspectives from participants in NORC Supportive Service Programs*. [Refereed]. Poster presented at the 143rd Annual Meeting & Expo of the American Public Health Association: Chicago, Illinois.

13. **Mauldin, R. L.,** Narendorf, S.C., & Mollhagen, A. (October 2015). *Social ties among first-semester MSW students: A social network analysis*. [Refereed]. Poster presented at the 61st Annual Program Meeting of the Council on Social Work Education: Denver, Colorado.

14. Greenfield, E. & **Mauldin, R. L.** (June 2015). *Make new friends, but keep the old? NORC programs' influence of peer relationships in later life*. [Refereed]. Paper presented at the 2015 Mini-Conference of the International Association for Relationship Research: New Brunswick, New Jersey.

15. Travis, D. & **Mauldin, R**. **L.** (January 2015). *Disentangling valuing multiculturalism, perspective-taking, and ethno-cultural empathy as inclusive leadership skills*. [Refereed]. Symposium paper presented at the Society for Social Work Research 19th Annual Conference: New Orleans, Louisiana.

16. **Mauldin, R. L.**, Narendorf, S. C., & Mollhagen, A. (December 2014). [Refereed]. *MSW cohorts: Preliminary results from a social network analysis.* Poster presented at the 2014 University of Houston Social Work Research Conference: Houston, Texas.

17. **Mauldin, R. L.** (February 2014). *Reciprocity in social work practice and research*. [Refereed]. Presented at the 1st Annual Social Science Lightning Talks, University of Houston: Houston, Texas.

18. Kao, D., Torres, L. R., Guerrero, E.G., **Mauldin, R. L.**, & Bordnick, P. S. (January 2014). *Spatial accessibility of drug treatment facilities and the effects on locus of control, drug abuse, and service use among heroin-injecting Mexican American men*. [Refereed]. Symposium paper presented at the Society for Social Work Research 18th Annual Conference: San Antonio, Texas.

19. Kao, D. & **Mauldin, R**. **L.** (December 2013). *A geo-ethnography of activity spaces and access to health services of aging minorities*. [Refereed]. Poster presented at the 2013 University of Houston Social Work Research Conference: Houston, Texas.

PRESENTATIONS ACCEPTED

1. Fujimoto, K., **Mauldin, R. L.**, Kuhs, L. & Schneider, J. (accepted March 2018). *Referral network for the delivery of pre-exposure prophylaxis (PrEP) among organizations that serve young men who have sex with men.* [Refereed]. Poster presentation at 3rd World Conference on Medical Sociology & Public Health: Dallas, TX.

2. Sampson, M., **Mauldin, R. L.**, & Yu, J. (accepted, January 2018). *Reducing postpartum depression, increasing self-efficacy among low-income mothers with a home visiting intervention.* [Refereed]. Oral presentation at the Society for Social Work Research 22nd Annual Conference: Washington, DC.

3. Yu, J., Sampson, M., & **Mauldin, R. L.** (accepted January 2018). *Parenting self-efficacy, childhood trauma and trajectory of perinatal depressive symptoms: A hierarchical linear model.* [Refereed]. Oral presentation at the Society for Social Work Research 22nd Annual Conference: Washington, DC.

PRESENTATIONS SUBMITTED

1. Miyawaki, C. E., Chrisman, T. C., **Mauldin, R. L.**, & Carman, C. R. (submitted February 2018). *Optometrists' referrals to community-based exercise programs: Findings from a mixed-methods feasibility study.* [Refereed]. Oral presentation at the 64th Annual Program Meeting of the Council on Social Work Education: Orlando, Florida.

2. **Mauldin, R. L.** & Narendorf, S. C. (submitted March 2018). *Factors associated with the social networks of assisted living facility residents: A social network analysis.* [Refereed]. Oral presentation at the Gerontological Society of America 2018 Annual Scientific Meeting: Boston, MA.

3. Fernandez, J., & **Mauldin, R. L.** (submitted March 2018). *Participation in and Distance to Group Activities among Older Adults Residing in an Assisted Living Facility.* **[**Refereed]. Oral presentation at the Gerontological Society of America 2018 Annual Scientific Meeting: Boston, MA.

4. Miyawaki, C., **Mauldin, R. L.**, & Carman, C. R. (submitted March 2018). *The feasibility of optometrists referring older patients to community-based exercise programs.* [Refereed]. Oral presentation at the Gerontological Society of America 2018 Annual Scientific Meeting: Boston, MA.

TEACHING EXPERIENCE

2016 Adjunct Professor
Research & Knowledge Building for Social Work Practice
Graduate College of Social Work
UNIVERSITY OF HOUSTON, Houston, Texas

2015 Teaching Assistant
Social Networks and Health
School of Public Health
UNIVERSITY OF TEXAS HEALTH SCIENCE CENTER AT HOUSTON, Houston, Texas

2014 Teaching Assistant
GIS for Social Work Practice and Research
Graduate College of Social Work
UNIVERSITY OF HOUSTON, Houston, Texas

GUEST LECTURES

Extramural

Mauldin, R. L. (October 2017). *Using UCINET for QAP correlation, MR-QAP, and QAP logistic regression.* PhD Course: Social Networks & Health. School of Public Health, University of Texas Health Science Center, Houston, TX.

Mauldin, R. L. (September 2017). *Network exposure analyses in UCINET and netdiffuseR.* PhD Course: Social Networks & Health. School of Public Health, University of Texas Health Science Center, Houston, TX.

Mauldin, R. L. (November 2016). *Using network analytic tools for curriculum mapping.* University of Maryland School of Social Work Self-study Group, Baltimore, MD.

Mauldin, R. L. (October 2016). *Quadratic assignment procedure: QAP correlation, MR-QAP, and QAP logistic regression in UCINET*. PhD Course: Social Networks & Health. School of Public Health, University of Texas Health Science Center, Houston, TX.

Mauldin, R. L. (October 2016). *Social network analysis: Calculating exposure using UCINET*. PhD Course: Social Networks & Health. School of Public Health, University of Texas Health Science Center, Houston, TX.

Mauldin, R. L. (December 2015). *Using UCINET for social network analysis.* PhD Course: Department of Health Promotion & Behavioral Sciences, University of Texas Health Science Center, School of Public Health, Austin, TX.
Mauldin, R. L. (October 2015). *Social network analysis: Calculating exposure using UCINET*. PhD Course: Social Networks & Health. School of Public Health, University of Texas Health Science Center, Houston, TX.

Mauldin, R. L. (October 2015). *Social network analysis: Introduction to UCINET*. PhD Course: Social Networks & Health. School of Public Health, University of Texas Health Science Center, Houston, TX.

Intramural

Mauldin, R. L. (April 2017). *Sociology Dissertation Improvement Grants from the National Science Foundation.* PhD Seminar: Grant Writing. Graduate College of Social Work, University of Houston.

Mauldin, R. L. (October 2016). *Software for qualitative analysis.* PhD Seminar: Qualitative Research Methods. Graduate College of Social Work, University of Houston.

Mauldin, R. L. (March 2016). *Applying for a pre-doctoral fellowship (F31) from the NIH.* PhD Seminar: Grant Writing. Graduate College of Social Work, University of Houston.

Mauldin, R. L. (October 2015). *Coding with NVivo*. PhD Seminar: Qualitative Research Methods. Graduate College of Social Work, University of Houston.

Barros Lane, L. & Mauldin, R. L. (March 2015). *Creating a doctoral student website.* PhD Seminar: Teaching in Higher Education. Graduate College of Social Work, University of Houston.

Mauldin, R. L. (October 2014). *Introduction to social network analysis*. MSW Course: Research Methods. Graduate College of Social Work, University of Houston.

SERVICE

College and University

2016-2017	Editor, *Perspectives on Social Work*
2015-pres	Editorial Board, *Perspectives on Social Work*
2015	Student Representative, PhD Committee, Graduate College of Social Work
2015	Member, Ad Hoc Grievance Committee, Bauer College of Business
2015	President's Round Table Discussion, University of Houston
2014	Co-Chair and Moderator, PhD Student Panel, Social Work Research Conference, University of Houston
2013-2014	Treasurer, Society for the Advancement of International Social Work

Professional

2017	Reviewer, *The Gerontologist*
2017	Co-reviewer, *Advances in Social Work*
2017	Reviewer in training, *The Gerontologist*
2016-2017	Reviewer, *SAGE Open*
2016	Student Volunteer, Annual Meeting of the Society for Social Work and Research
2014	Student Volunteer, Annual Meeting of the Society for Social Work and Research
2010-2013	Committee Member, Federation of State Massage Therapy Boards
2010-2013	Content Expert for the Massage and Bodywork Licensing Exam

Community

2017	Hurricane Harvey Relief Shelter, The Forge for Families, Houston, TX
2017	Mapping Consultant, Interfaith Ministries Meals on Wheels, Houston, TX
2015-pres	Geographic Information Systems Consultant/Map Designer, Care for Elders, Houston, TX
2014-pres	Board of Directors, Gayle Wells Foundation for Early Onset Alzheimer's
2014	Advisory Board Member, Aging in Place Village Advisory Board, Jewish Family Services
2012-2013	Volunteer, Marcus Garvey Liberation Garden

PROFESSIONAL EXPERIENCE

2014	Jewish Family Service, Houston, Texas Social Work Intern
2012-2013	Greater Houston Area Health Education Center, Houston, Texas Social Work Intern
2001-2012	Rocky Mountain Institute of Healing Arts, Durango, Colorado Founder, Executive Director, and Instructor

1993-2001 Human Resources Professional
Positions including Director of Human Resources, Compensation Analyst, and Employment Coordinator in various healthcare settings including a home health agency, medical school, and large medical center.
Winston-Salem, Albemarle, and Charlotte, North Carolina

1989-1993 Social Security Administration, Winston-Salem, North Carolina
Claims Representative

HONOR SOCIETIES AND AWARDS

2015 Phi Kappa Phi
2014-2015 AGE-SW Pre-Dissertation Initiative, 5th Cohort, Association for Gerontology Education in Social Work.
1986 Pi Sigma Alpha
1985 Phi Beta Kappa

PROFESSIONAL LICENSES AND MEMBERSHIPS

2016-pres Licensed Master Social Worker, State of Texas #62625
2015-pres National Association of Social Workers
2015-pres Council on Social Work Education
2014-pres Association for Gerontology Education in Social Work
2014-pres Gerontological Society of America
2014-pres International Network for Social Network Analysis
2010-pres Licensed Massage Therapist, State of Texas #MT111177

DATA ANALYSIS SOFTWARE IN USE

Statistical environments/software

R
SPSS

Social network analysis and visualization

Gephi
Igraph package for R
MPNET (Exponential Random Graph Modeling)
NetDraw
RSiena package for R (SIENA models)
UCINET (sociometric network data analysis)