EXPLORING THE RELATIONSHIP BETWEEN COGNITIVE HEALTH AND THE SOCIAL ENVIRONMENT OF OLDER ADULTS

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Submitted to the Graduate Faculty of

the Graduate School of Public Health in partial fulfillment

of the requirements for the degree of

Doctor of Philosophy

University of Pittsburgh

2013

UNIVERSITY OF PITTSBURGH

GRADUATE SCHOOL OF PUBLIC HEALTH

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ABSTRACT

Cognitive health is an important aspect of successful aging, and includes maintaining several cognitive functions such as memory, decision-making, and executive function. Various aspects of older adults' social environment may play a role in cognitive health. Three studies were conducted, aimed at testing the relationships between memory performance and two socio-environmental factors (social networks and social activities) in a community-based sample of older adults. Study 1 examined the associations between memory performance and several structural characteristics of social networks using linear regression models. Better memory performance was associated with having larger networks, more connected ties, and greater potential access to social capital (less network constraint). Study 2, a qualitative in-depth interview study, explored the types and purposes of social activities in late life, as well as their potential implications for cognitive health, using a grounded theory approach. From this study, we found that older adults tended to participate in four types of social activities—Altruism, Creativity, Game and Motion. Building off our findings from the qualitative study, Study 3 examined the associations between four social activity types and memory performance via logistic regression models. We found that those who participated in Altruism and/or in two or more of these social activity types in a typical week were more likely to have better memory performance. These findings raise a number of questions related to the importance of emotional

closeness, social capital, enjoyment, creativity, and volunteering in late life, and how these factors could be important for memory and preserving cognitive health.

Maintaining cognitive health in late life is an emerging public health issue with important implications for the well-being of older adults and families in an aging society. Future research is needed to confirm whether these aspects of the social environment are important for memory and overall cognitive functioning in late life. Public health practitioners should consider interventions that enhance older adults' social network structure or encourage participation in different types of social activities as they may play an important role in cognitive health and well-being in late life.

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ACKNOWLEDGMENTS

I am especially grateful for all of the mentorship I have received throughout this endeavor. First, I have to acknowledge all of the support and mentorship from my dissertation committee. To my dissertation chair, Dr. Steve Albert, thank you for teaching and challenging me to be innovative and a better researcher. To my academic advisor, Dr. Jeanette Trauth, thank you for the advice on the car rides home and little pep talks along the way. To Dr. Patricia Documét, you understood my research interests from the very beginning, and you have always encouraged me to be brave. To Dr. Jennifer Lingler, thank you for encouraging me to pursue my interests, especially those involving creativity and art engagement. To John Marx, while I know you hate being thanked, you have no idea of the impact you have had on my life and that of other students. John, you are truly a friend, mentor, confidant, and someone whom I consider a great source of companionship.

There are many others that have supported me this past four years. A special thanks to Dr. Tiffany Hughes for the opportunities to do research together, and especially for your friendship. I would not have made it through this without your support and guidance. I would also like to acknowledge the financial support from the Myrna Silverman Scholarship. I also want to thank several others who have either supported me emotionally and/or professionally over these past four years: Linda Duchak, Gerry Barron, Claudia Warner, Dr. Ron Voorhees, Dr.

Jen Morse, Dr. Beth Nolan, Dr. Ed Ricci, Dr. Hasan Guclu, Dr. Ellen Smith, Dr. Mary Hawk, Dr. Yll Agimi, Todd Bear, Jen King, and Alexa Swailes.

Finally, I could not have done this without the love and support of my friends, family and my partner, Jason Kershner. He knows more about this dissertation than anyone would want. Thank you for always believing in me. Where is your honorary PhD? Well, hopefully this will work—I dedicate this dissertation to you and to us growing old together and pursing our dreams. I love you so much!

1.0 INTRODUCTION

1.1 COGNITIVE HEALTH

Understanding how to maintain cognitive health in late life is critical and a growing public health concern. The Centers for Disease Control and Prevention's Healthy Brain Initiative has defined cognitive health as being able to perform all of the mental processes that are collectively known as cognition—memory, language, attention, executive function, judgment, as well as skills such as driving and the ability to lead a purposeful life (CDC, 2011). Severe cognitive health problems, including Alzheimer's (AD) or other dementias, result in decreased independence and well-being, increased health care costs, institutionalization, and high levels of caregiver burden (Hughes & Ganguli, 2009).

It has been suggested that cognitive health encompasses a continuum of cognitive function, ranging from cognitive decline to impairment and dementia (Lee et al., 2010). Different terms are used to define cognitive health problems in late life. Cognitive decline refers to a decline in cognitive health that impacts older adults' everyday functioning and independence (Daviglus et al., 2010; Hughes, 2010). Cognitive impairment is characterized as a decline in one or more cognitive domains without the presence of dementia (Plassman et al., 2008). These cognitive health problems may also suggest an increased risk of dementia and mortality (Lezak, 2004).

The Aging, Demographics and Memory Study (ADAMS) – a nationally representative longitudinal study of adults age 71 and older (Plassman et al., 2008) – suggests that cognitive impairment is more prevalent in the U.S. than dementia. Plassman et al., (2008) estimated that more than 5.4 million people in U.S. in 2002 had some type of cognitive impairment and about 2.0 million had AD (Table 1). Considering those 60 years and older in the U.S., it was suggested that there were about 4.8 million with dementia and 3.3 million with AD. Using the same sample to estimate incidence of cognitive impairment and dementia from 2001-2009, the ADAMS study estimated that about 3.4 million individuals aged 72 and older in the U.S. developed incident dementia, of which 2.3 million developed AD and 637,000 developed vascular dementia. It was estimated that 4.8 million individuals in the U.S. also developed cognitive impairment (Plassman et al., 2011). Thus, the overall incidence of cognitive impairment was higher than dementia in the U.S., and Plassman and colleagues (2011) suggest that interventions for those with cognitive impairment may help to prevent further cognitive decline and progression to AD, as well as the costs and burdens associated with caring for these individuals.

The number of people living with cognitive health problems is expected to increase dramatically with the aging of the Baby Boomer generation. By the year 2050, it has been estimated that number of persons with AD will triple, with more 13 million older adults in U.S. having AD (Hebert, Weuve, Scherr, & Evans, 2013). The increasing number of older adults with AD and other dementias represents a future public health burden, further compounded by rising health care costs and the shortage of health care workers. The costs associated with caring for those with AD in 2012 were estimated at $200 billion in health care costs (including $140 billion to Medicare and Medicaid), and more than 17 billion hours of unpaid care by caregivers (Alzheimer's Association, 2012). These costs will surge in 2050 at an estimated $1.1 trillion

dollars, as well as the increasing demands on caregivers and health care workers. Efforts aimed at preventing or delaying cognitive impairment and dementia could have significant impact on the future prevalence of dementia and in reducing the burdens to individuals, families, and the health care system.

Table 1. National prevalence of cognitive impairment and Alzheimer's disease

Age	Cognitive impairment		Alzheimer's disease	
	Prevalence % (95% CI)	Population estimate (95% CI)	Prevalence % (95% CI)	Population estimate (95% CI)
71-79	16.0 (11.5–20.5)	2.29 (1.65–2.94)	5.5 (2.6–8.4)	0.79 (0.37–1.20)
80-89	29.2 (24.3–34.1)	2.41 (2.00–2.81)	9.7 (6.4–13.1)	0.80 (0.528–1.081)
90+	39.0 (25.7–52.2)	0.73 (0.48–0.98)	22.4 (11.9–32.9)	0.42 (0.22–0.62)
Total	22.2 (18.7–25.7)	5.43 (4.57–6.29)	8.2 (6.5–10.0)	2.01 (1.59–2.45)

Source: The Aging, Demographics and Memory Study (Plassman et al., 2008), Population estimates in millions, CI = confidence interval.

1.1.1 Memory and the Memory Impairment Screen

Memory impairment is a common complaint of older adults (Peres et al., 2011). Memory impairment in late life is also one of the most common features of dementia, and may indicate an early manifestation of AD (Lipton et al., 2003). Those with cognitive impairment and early AD are more likely to have problems with episodic memory—learning and recalling new information (Petersen et al., 1997; Plancher, Tirard, Gyselinck, Nicolas, & Piolino, 2012). Episodic memory is typically assessed by having participants recall or recognize some information with the use of

a semantic cue—a broader category that represents the newly learned information (Kuslansky, Buschke, Katz, Sliwinski, & Lipton, 2002).

Efforts have been made to improve early detection of memory impairment. Telephone screenings are a low-cost alternative to in-person assessments and may help with assessing dementia and other cognitive health problems in community-settings. Some of the most common telephone screening tools include the telephone version of the Mini-Mental State Exam (TMMSE) (Newkirk et al., 2004), the Telephone Instrument for Cognitive Status (TICS) (Plassman, Newman, Welsh, & Helms, 1994), the Memory Impairment Screen by telephone (MIS-T) (Lipton et al., 2003), and the Category Fluency Test (CF-T).

However, it is important to note that the use of telephone-based screening does not come without its limitations (Wolfson et al., 2009). First, telephone administration limits the types of cognitive domains that can be assessed. Second, telephone administration doesn't allow researchers to standardize the environment or minimize distractions. Finally, hearing difficulties can result in participants being misclassified as being cognitively impaired.

Of particular concern is the sensitivity and specificity of these telephone batteries in detecting cognitive impairment and minimizing the time burden on participants. According to Buschke et al. (1999), the MIS and MIS-T have been found to have excellent psychometric properties (i.e., good alternate forms reliability, high construct validity for memory impairment, and good discriminant validity, reliability, sensitivity, specificity and positive predictive value). However, this screening tool only assesses episodic memory via a delayed recall.

The MIS and MIS-T have been found to outperform the three word memory task (Kuslansky et al., 2002), may be more sensitive than the MMSE in detecting Alzheimer's (Buschke et al., 1999), and they have excellent specificity and sensitivity when compared to the

TICS and CF-T (Lipton et al., 2003). Beinhoff, Hilbert, Bittner, Gron, and Riepe (2005) have also found this tool to have high sensitivity and specificity in identifying those with mild cognitive impairment (MCI). Finally, the MIS-T is considered a time efficient telephone screen (four minutes) compared to other telephone screenings (TICS and TMMSE) that take five to ten minutes.

1.2 SOCIAL ENVIRONMENT AND COGNITIVE HEALTH

With the dramatic growth that is expected in the aging population over the next four decades, efforts must be aimed at identifying effective prevention strategies for preserving cognitive health in late life. Currently, there are no clinically proven therapies for maintaining cognitive health; however, epidemiological studies have shown that socially active older adults tend to have better cognitive health. Further, these studies suggest that maintaining a socially integrated lifestyle and participating in social activities may be important for cognitive health.

It has been suggested that one's social environment – comprised of social relationships and interpersonal interactions – provides some benefits for cognitive health in late life. In figure 1, we provide a conceptual framework for how the social environment may impact cognitive health. Since the early 80's, researchers have demonstrated that social interactions promote psychological well-being and decreased rates of morbidity and mortality (Smith & Christakis, 2008). In fact, several studies have shown that one's social relationships can provide protection from life stresses, depression, risk of institutionalization, loneliness, and cognitive decline and dementia (Crooks, Lubben, Petitti, Little, & Chiu, 2008; Holtzman et al., 2004; Rook, 1994; Rook & Ituarete, 1999).

1.2.1 Social Networks

The majority of the research on older adults' social environments has examined the relationship between social networks and various health outcomes. Social networks are the webs that connect individuals to one another (Lubben, 1988). Studies have concluded that there is a strong link between social networks and health. In fact, evidence of this can be seen in numerous studies on networks and networks and health behaviors (smoking and physical activity) and health outcomes (obesity, mood, cognitive health and disability) (Crooks et al., 2008; Fratiglioni, Wang, Ericsson, Maytan, & Winblad, 2000; Holtzman et al., 2004; Smith & Christakis, 2008; Zunzunegui, Alvarado, Del Ser, & Otero, 2003). These studies suggest that health-related factors either spread in social networks or are associated with various network characteristics.

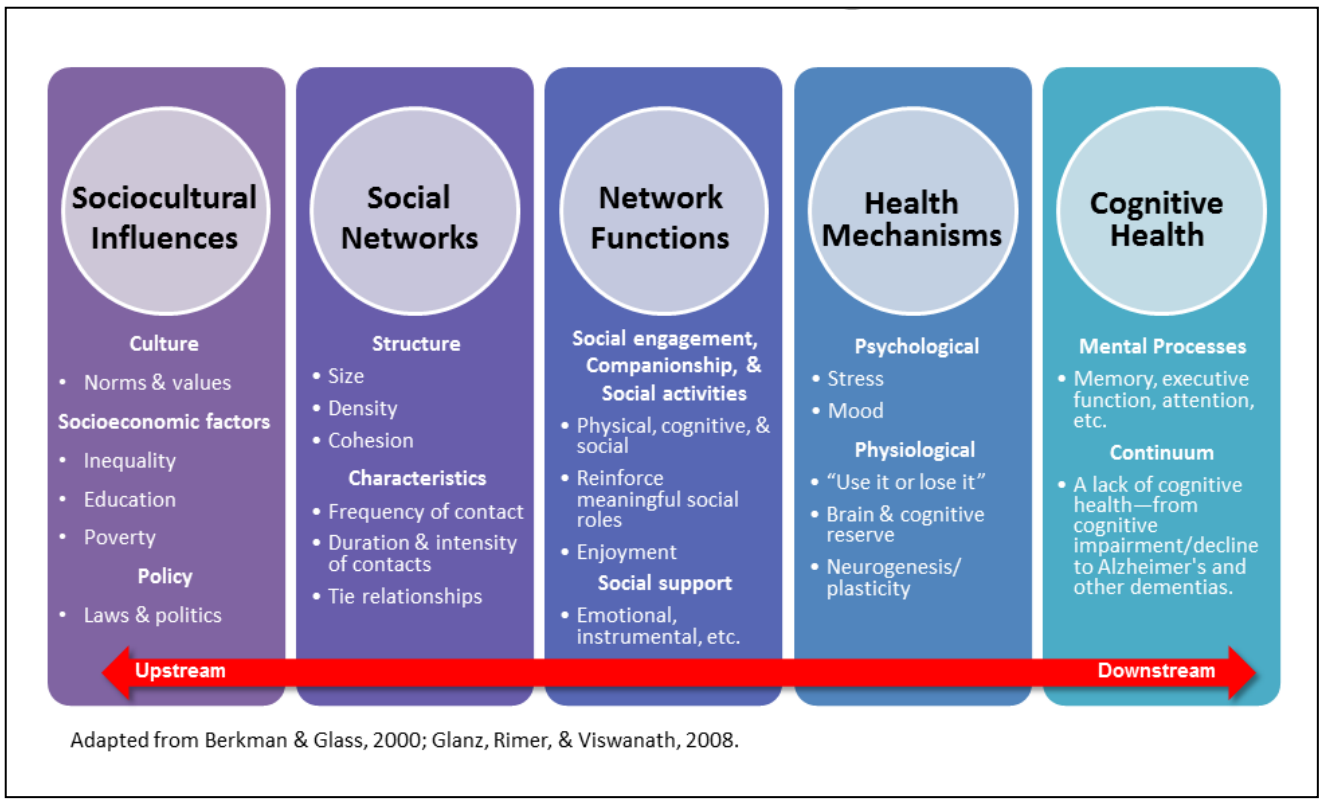

Figure 1. Conceptual model: How the social environment could affect cognitive health

Social networks consist of the ties and types of relationships that make up a person's social world. Studying networks can provide a better understanding of the mechanisms and processes involved and how social structures impact individuals and groups. Networks can also be measured on different ecological levels. At the individual level, egocentric networks (personal or local networks) are concerned with the ego, or the individual, and all of his/her social ties or alters (Smith & Christakis, 2008; Valente, 2010). At the community level, sociocentric networks (sociometric or complete networks) are concerned with all of the connections among a community or population. Sociocentric networks can be difficult to measure because they require a more extensive collection of data from the ego and all of the named alters.

The simplest way of studying networks is to examine dyadic relationships or ties between two people. This is a common practice in studies utilizing egocentric networks. Dyadic relations are comprised of four basic types: similarities, social relations, interactions and flows (Smith & Christakis, 2008). Research on older adults' social networks and cognitive function is mostly comprised of these egocentric elicitations.

Overall structural characteristics of networks tend to include the size, density, tie strength, diameter, centrality, cohesion, reciprocity, and composition (Berkman & Glass, 2000; Rook, 1994; Valente, 2010). Density is measured by calculating the percentage of ties that exist in a personal network divided by all possible ties within the network. Diameter is the length of longest tie between two actors. Cohesion is measured by several different centrality measures, such as degree—the number of links to and from a person; and betweenness examines the position in the network (Smith & Christakis, 2008). Reciprocity, sometimes referred to as mutuality or symmetry, is concerned with the number of mutual ties among actors. Lastly, composition represents the types of ties (friends, family, and acquaintances) in networks.

Several observational studies have found that certain network characteristics are associated with better cognitive health in old age (Crooks et al., 2008; Fratiglioni et al., 2000; Holtzman et al., 2004; Zunzunegui et al., 2003); however, less is known about the relationship between network structures and cognitive health. Studies have found that having a smaller number of social connections (a more limited social network) is associated with an increased risk of dementia (Fratiglioni et al., 2000), and having no connections can double one's risk of cognitive decline (Bassuk, Glass, & Berkman, 1999).

In addition, very few have examined how structural characteristics like centrality, density, and composition are related to cognitive health in late life. Structural network characteristics may provide further insight into the aspects of social networks that are important. For instance, denser networks may impact cognitive health by providing more opportunities for information, social support, and access to other resources (B. Cornwell, Laumann, & Schumm, 2008). A study examining the network structure of older adults found that position in a network was important for cognitive health (B. Cornwell, 2009). Cornwell found that older adults with better cognitive health were more likely to span structural holes—meaning they were more likely to occupy a position in the network that provided access to important and novel social resources.

On the other hand, a recent longitudinal study found that the size of one's social network is less important than the quality of the connections (Amieva et al., 2010). Being satisfied and sharing equal exchanges (reciprocity) with social connections were found to be more protective against dementia than network size over 15 years. It is also important to consider closeness or the cohesiveness of networks. Studies have shown that closer connections are healthier (Bruhn, 2009), and perhaps they have better cognitive health. Bruhn (2009) suggests that cohesiveness of a group or network could influence the availability or value of resources that are provided.

Having less cohesive networks could result in decreased access to social support and other types of resources and information. Additionally, Kawachi and Berkman (2000) have suggested that cohesiveness may represent an absence of conflict and stronger social bonds among connections.

Therefore, maintaining social connections in late life may be beneficial because they provide various social opportunities or transactions with others. Berkman and Glass (2000) have referred to these as potential mediating pathways for how social relationships may influence health. The social functions provided by relationships, such as social activities and social support, may benefit cognitive health by introducing new life experiences that are rewarding, stress relieving, and at the same time cognitively complex and stimulating (Holtzman et al., 2004).

1.2.2 Social Activities

Society encourages or even expects that one's youth features an active pursuit of social opportunities, and yet maintaining a vibrant and socially active life seems to be equally important in old age. Participating in social activities throughout the lifespan is associated with better health and longevity. In fact, longevity has been associated with having a more active and integrated social life (Holt-Lunstad, Smith, & Layton, 2010).

It is difficult to study this body of research, as much of the literature has used different terms to represent social activities. Adding to further misunderstandings, the inherent heterogeneity in how social activity terms are conceptualized and measured across studies makes it even more difficult to study this body of research. Work done in this area tends to refer to one of the following concepts (Figure 2): social activities, social engagement (Berkman & Glass, 2000; Carstensen & Hartel, 2006) or companionship (Rook, 1987). Social activities are broadly

defined in the literature as participation in activities with others (Ajrouch, Blandon, & Antonucci, 2005). Social engagement represents participation in social and productive activities (Glass, De Leon, Bassuk, & Berkman, 2006; Mendes de Leon, Glass, & Berkman, 2003). Companionship is conceptualized as doing enjoyable activities with others for non-productive reasons (Rook, 1987; Rook & Ituarete, 1999). There is also a rich body of work that focuses on the detrimental effects of social isolation (Nicholson, 2012), which is not covered in this review.

Quite a bit of historical and theoretical work has been done on the role of social activities in late life. The activity theory of aging (Atchley, 2006) states that activities are important for life satisfaction and subjective well-being. Lemon, Bengtson, and Peterson (1972) built upon this theory by identifying three distinct types of activities: 1) informal activities (social activities) done with close social connections; 2) formal activities or social activities done with organizations and service providers; and 3) solitary activities (Ajrouch et al., 2005). Longino and Kart (1982) explored the association of each of these activities with life satisfaction in old age. They found that social activities with close connections had the strongest association with life satisfaction; doing solitary activities was not associated life satisfaction, and doing formal activities was associated with less life satisfaction. Subsequent studies have found varying results, but most have found that social activities with close contacts are more likely to be associated with greater well-being in later life (Adams, Leibbrandt, & Moon, 2011).

	Social Activities	Social Engagement	Companionship
Definition	Activities done with close connections.	Productive and leisure social activities.	Social activities that are done purely for enjoyment.
Cognitive health studies	Yes	Yes	No
Sources	(Ajrouch, Blandon, & Antonucci, 2005)	(Glass, De Leon, Bassuk, & Berkman, 2006)	(Rook, 1987)

Figure 2. Various social activity-related concepts in the literature

There is also substantial evidence from several population-based studies that individuals with lower levels of participation in social activities were at greater risk for cognitive health problems as well as other health problems (E. Y. Cornwell & Waite, 2009). Further, studies have found that participation in social activities was associated with better cognitive health, independent of age, education, income, (Bennett et al., 2005; Singh-Manoux, Richards, & Marmot, 2003) and participation in physically and cognitively stimulating activities (James, Wilson, Barnes, & Bennett, 2011). Findings from the Rush Memory and Aging Project (James, Wilson, et al., 2011) suggest that participation in social activities is associated with a reduced rate of cognitive decline over five years. Findings from the Whitehall II study (Singh-Manoux et al., 2003) suggest that social activities involving a greater level of social interaction were associated with better cognitive health. A recent intervention trial of 235 older adults allowed participants to self-select a social activity group (therapeutic writing, group exercise, or art experience) based on his/her interests, and then be randomized to the control or social activity group (Pitkala, Routasalo, Kautiainen, Sintonen, & Tilvis, 2011; Pitkala, Routasalo, Kautiainen,

& Tilvis, 2009). After three months, those in the intervention groups had significant improvements in cognition compared to the control groups (Pitkala et al., 2011).

1.2.3 Social Engagement

Social activities can also be characterized by the purpose they fulfill. Social engagement has described social activities as the performance of meaningful social roles for leisure or productive reasons (Glass et al., 2006). Examples of productive activities include working in the yard or garden, preparing meals, going shopping, and unpaid volunteer work or paid employment. Categories used to describe leisure activities include going to movies, restaurants or sporting events; playing games such as board games, bingo, or cards; attending religious services; and participating in social and community groups.

There are a number of studies that suggest that social engagement may also delay cognitive decline in late life (Bassuk et al., 1999; Carstensen & Hartel, 2006; Krueger et al., 2009). For example, a study examining social networks and social engagement in community-dwelling Spanish older adults found that poor social connections, infrequent participation in social activities, and social disengagement were associated with an increased risk of cognitive decline (Zunzunegui et al., 2003). Another longitudinal study found a positive relationship between increased levels of social engagement and executive function and episodic memory over 50 years (Seeman et al., 2011). Finally, a study examining social engagement trajectories over 17 years found that those who remained high and/or increased their levels of social engagement had better cognitive health (Thomas, 2011b).

Others have defined social engagement as the “maintenance of social connections and participation in social activities” (Krueger et al., 2009). Additionally, social engagement has

been used as an umbrella term by others to refer to various social aspects (social support, social stress, social resources and social contact). Many of these social aspects have been found to be associated with cognitive health in later life (Sampson, Bulpitt, & Fletcher, 2009; Seeman et al., 2011).

Some have challenged measures of social engagement because certain activities can be done alone. Furthermore, some argue that less is known about the quality of the activities and the importance of differentiating between positive and negative social experiences (Thomas, 2011a); however, separating out the truly beneficial aspects of social activities may be difficult. Another limitation involves the use of composite scores rather than examining the specific types of activities that are more or less protective. Finally, much less is known about what contributes to meaningful social roles. Exploring these research gaps is crucial to better understanding the link between social engagement and cognitive health.

1.2.4 Companionship

Companionship can be differentiated from social engagement and the broad definition of social activities in that it is done purely for enjoyment and nonproductive reasons. Karen Rook defines companionship as sharing leisure or other activities such as recreation, humor and fun with others. She states that companionship is done "primarily for the intrinsic goal of enjoyment." Rook suggests that older adults benefit most from social activities that encompass pleasurable interactions and shared leisure. Companionate activities include: having someone over for a meal; visiting someone's home; going out somewhere with someone (e.g., restaurant, movie, play, or other activity); and joining a group for conversation, lunches, bridge, etc. (Rook, 1987); these social activities overlap with activities considered to be social engagement. Yet, the unique

elements of companionship-based activities are that they are self-selected, occur in a somewhat egalitarian environment, and done purely for enjoyment. It has also been suggested that companionship may occur more often with friends than family members (Rook, 1994). Empirical studies have demonstrated that companionship is a distinct construct, and that it is only moderately correlated with social support (Rook, 1987).

Very little if any studies have examined companionship, especially as conceptualized by Rook, in relation to cognitive health in late life. However, evidence from several studies suggests there is a link between companionship and health in late life. Companionship has been associated with lower levels of loneliness, better relationship satisfaction, less emotional distress (Rook, 1987, 1994; Rook & Ituarete, 1999) and reporting better overall health (Ashida & Heaney, 2008). Therefore, it seems plausible that companionship could have similar benefits to cognitive health as has been found in studies with social engagement.

Social activities, therefore, may encompass a broad range of goals, including leisure, productivity, and enjoyment (Glass, de Leon, Marottoli, & Berkman, 1999). Several more recent observational (James et al., 2012; James, Wilson, et al., 2011; Paillard-Borg, Fratiglioni, Xu, Winblad, & Wang, 2012; Wang et al., 2013) and population-based studies (Geda et al., 2011; Hughes, Flatt, Fu, Chang, & Ganguli, 2012), as well as a randomized control trial (Pitkala et al., 2011), provide support for the link between the social activities and cognitive health.

1.2.5 The Role of Enjoyment in Social Activities

An essential element for why social activities, particularly those defined as companionate, may be important for cognitive health is that is that they provide enjoyment. According to Rook (1987), social activities provide the context for older adults to share rewarding moments with

others and participate in mutually enjoyable activities. While others have emphasized the importance of variety, novelty and challenge (Holtzman et al., 2004), enjoyment could encompass many of these elements. Engagement in social activities provides an opportunity to invest time and energy to participate in one's interests (Mannell, 1993) and experiencing a flow state while doing them (Csikszentmihalyi, 1991). Csikszentmihalyi's definition of flow illustrates the role that enjoyment may play in social activities. His phenomenology of enjoyment is comprised of eight key elements: 1) a balance between skill and challenge; 2) deep concentration; 3) clear goals; 4) immediate feedback; 5) little or no worries and frustrations; 6) a sense of control over actions; 7) disappearance of self-concern; and 8) the altering of time (Csikszentmihalyi, 1991). Further, flow producing activities are autotelic, which means that simply doing them is enjoyable. These eight elements have been associated with continued participation over time in game playing and adherence to physical activity programs (Csikszentmihalyi, Abuhamdeh, & Nakamura, 2005).

It is unclear whether enjoyment from social activities plays an important role in the cognitive health of older adults. Researchers have found that enjoyment promotes older adults' adherence to group-based, physical activity interventions (Mullen et al., 2011). Another study with about 200 community-dwelling older adults showed that greater enjoyment was experienced when cognitive abilities aligned with the difficulty of the activity (Payne, Jackson, Noh, & Stine-Morrow, 2011). Finally, a qualitative study with 70 older adults in the United Kingdom (Ball, Corr, Knight, & Lowis, 2007) identified enjoyment, pleasure and relaxation as motivators for participation in leisure activities. These studies allude to a connection between enjoyment and social activities in late life, but less is known about how enjoyment might be related to cognitive health.

1.2.6 Types of Social Activities

Very little research has examined the types of social activities that may promote cognitive health. Roger Caillois, a French philosopher and sociologist, wrote about the purpose of play and games in society (Caillois, 1961). Caillois suggests that play and games are indeed social but done best in small groups. He depicts play and games as falling into four specific categories (Figure 3). *Agôn* represents activities that encompass elements of competition (e.g., sports or chess); *Alea* describes games of chance (e.g., playing bingo or gambling); *Ilinx* or *Vertigo* entails activities that alter one's consciousness (e.g., riding a merry-go round or skydiving); and *Mimicry* involves activities that create new worlds or allow for role playing (e.g., theater or painting). In some cases, activities may fall into several categories. For instance, certain games might involve competition and chance such as poker, and others might involve simulation and an altering of one's perception like dancing.

Figure 3. Play and games in society

While broader types of activities, such as leisure activities, have received much more attention in aging research, much less is known about the specific types of leisure activities. More recent research from occupational therapy has identified different types of leisure activities. Ball et al. (2007) found that older adults tended to participate in five types of leisure: active, passive, social, hobbies, and other. Examining social leisure, older adults were found to participate in socializing, visiting with family, church and friendship activities, and volunteering. Ball and colleagues (2007) identified that older adults in their study tended to engage in social leisure more than any other type of leisure activity.

Adult leisure activities were examined in the Victoria Longitudinal Study in order to better represent those done over the lifespan (Jopp & Hertzog, 2010). Three types of social activities were identified: private, public and religious. These social activities were very similar to research on the activity theory of aging (e.g., informal, formal and solitary activities). Similar to informal activities, private social activities were those done with close contacts (going out with friends, attend parties, visiting with family). Public social activities were those group-centered activities (volunteering, attending club meetings, going to organized social events), which are similar to the activity theory's concept of formal activities. Finally, religious activities were another form of social activities that involved going to church/synagogue and engaging in prayer or meditation. Jopp and Hertzog (2010) also examined how these three social activities were associated with cognition. Participating in private social activities was the only social activity of the three that was associated with several cognitive health outcomes, including episodic memory. Further research is needed to determine which types of social activities, especially those done with friends and family, may be important for cognitive health and successful aging.

1.3 PHYSIOLOGICAL AND PSYCHOLOGICAL MECHANISMS

There are a number of possible explanations for the association between the social environment (social networks and social activities) and cognitive health in late life. Several mechanisms have been proposed to explain this relationship, and most likely there is more than one mechanism involved (Berkman, Glass, Brissette, & Seeman, 2000). The intent here is not to describe all of the possible mechanisms, but instead review some of the most common ones mentioned by researchers examining how social networks and social activities may be important for cognitive health. We will describe these potential mechanisms, both psychological and physiological, and then provide some examples from the literature that provide support for how social networks and participation in social activities could be important for cognitive health.

1.3.1 Brain Health

1.3.1.1 Brain and Cognitive Reserve

The health of the brain is critical for maintaining cognitive health in late life. The concept of brain/cognitive reserve has been proposed to explain the brain's ability to compensate for neural deficits related to aging or disease pathology and prevent or delay cognitive manifestations (Stern, 2011). Support for this is based on findings that show that the level of brain pathology does not consistently predict cognitive performance in later life (Stern, 2002). The concept of reserve can be broken down into two subsets: brain reserve and cognitive reserve (Tucker & Stern, 2011). Brain reserve suggests a larger brain or increased neuronal count could be protective against cognitive decline. Further, brain reserve depicts how the level of interconnectivity among the neurons and the strength of such connections are important for brain

health (Mortimer, 1997). Cognitive reserve represents the flexibility and efficiency of the brain in accessing available brain reserve. Neuroplasticity and neurogenesis refer to the brain's flexibility and ability to generate new neurons, respectively; and these mechanisms form an integral part of the reserve hypothesis. Several researchers (Singh-Manoux et al., 2003; Tucker & Stern, 2011) have suggested that these fundamental mechanisms of neuronal adaptation may be the reason for why social and complex interactions may be important for cognitive health.

Studies on cognitive reserve have suggested that it is not fixed, and it can be influenced by experiences and exposures across the lifespan. In animal models, an enriched environment has been found to induce a spectrum of positive neurobiologic changes, including increased hippocampal neurogenesis, elevated synaptogenesis and synaptic plasticity, altered gene expression, increased protein trafficking and other post-translational processes, enhanced cerebrovasculature, reduced inflammation, decreased insulin resistance, and reduced brain beta-amyloid deposition (Costa et al., 2007; Nithianantharajah & Hannan, 2009). This has been found in rodent models of aging, Alzheimer's disease and other brain disorders.

Research with humans has yielded evidence that enriched environments may also benefit older adults' cognitive health. For instance, a pilot study examined the effects of volunteering (The Experience Corps Program) on cognitive health and neuroplasticity in eight, African American women at risk for cognitive impairment over six months (Carlson et al., 2009). With the use of functional magnetic resonance imaging (fMRI) before and after the intervention, researchers found that volunteering was associated with increased activity in the prefrontal cortex—an area of the brain linked to memory, executive function, and other functional abilities. A more recent study found that a higher level of social engagement was associated with larger total brain and gray matter volume (James et al., 2012). Social engagement may help to preserve

brain tissue; and James and colleagues (2012) did not find support for the alternative—smaller or shrinking brain volumes being associated with less social engagement.

1.3.1.2 "Use It or Lose It"

The "use it or lose it" hypothesis states that mental exercise encourages cognitive health by increasing both brain and cognitive reserves. In essence, the brain is a muscle that can be exercised to ensure optimal performance in late-life (Bielak, 2010). James, Wilson, et al. (2011) have proposed that complex interpersonal exchanges may support the "use it or lose it" hypothesis. Social activities may improve cognitive health by exercising those areas used for memory, problem solving, and comprehension (Carstensen & Hartel, 2006). Glass et al. (2006) have suggested that "use it or lose it" involves the interaction of various physiological systems (cognitive, cardiovascular, neuromuscular, and endocrine systems), and that these interactions may improve or maintain cognitive health in late life. Numerous studies on the protective effects of education, socio-economic status, work complexity, leisure activities (physical, social, and mental) and social networks also support the brain/cognitive reserve hypothesis (Fratiglioni & Wang, 2007).

There is also disagreement over the validity of this hypothesis. For instance, Salthouse (2006) has argued that there is still too little empirical evidence that activities can moderate the rate of cognitive decline in late life. In contrast, Schooler has argued that longitudinal studies as well as other experimental studies provide plenty of evidence to support this hypothesis (Schooler, 2007). Interestingly, those in support of "use it or lose it" believe that it may be directly responsible for the protective effects found by numerous studies on the relationship between a socially integrated lifestyle and better cognitive health in old age.

1.3.1.3 Social Cognition

Engaging in social activities also requires the use of several complex processes related to social cognition. Social cognition represents the processing of information about social matters—the self, others, and the interaction of the two (Blanchard-Fields & Horhota, 2006; Pillai & Verghese, 2009). This includes the faculties necessary for remembering and understanding people's faces, facial expressions, voices, non-verbal cues and body language; making judgments about people's personalities and motives; and finally reacting to all of these social exchanges (Sabat & Gladstone, 2010). Additional indicators of social cognition include being able to experience and express a range of emotions, such as empathy, excitement, humor, creativity, pleasure, relaxation, and affection. Engaging in these complex processes could be beneficial for cognitive health in late life.

1.3.2 Stress

1.3.2.1 Cortisol

Another probable mechanism that may contribute to the beneficial effects of the social environment in late life involves the ability to cope with stress. The brain is especially sensitive to stress throughout the lifespan (Lupien, McEwen, Gunnar, & Heim, 2009). Prolonged stress results in the over-production of cortisol, a stress hormone secreted by the adrenal glands. Studies have found that higher cortisol levels over time were associated with worse cognitive functioning, especially visual-spatial memory, executive function and processing speed (Franz et al., 2011). However, some studies have found that higher cortisol levels do not predict cognitive health problems (Peavy et al., 2012).

1.3.2.2 Allostatic Load

Studies have also shown that positive social experiences in late life are associated with a lower allostatic load (Seeman, Singer, Ryff, Dienberg Love, & Levy-Storms, 2002). According to McEwen (McEwen, 1998), allostatic load represents how stress exhausts the body. Having a higher allostatic load is harmful and associated with increased mortality, vascular disease, and physical and cognitive health problems (Seeman et al., 2002). Seeman and colleagues (2002) also found that older adults with three or more social ties had a much lower allostatic load than those with fewer ties.

1.3.2.3 Meaningful Social Roles

Psychological mechanisms may also contribute to understanding how participating in social activities in late life may improve older adults' ability to cope with stress. Berkman and Glass (Berkman & Glass, 2000) speculate that participation in social activities may relieve stress by encouraging meaningful social roles for older adults. These roles may provide a sense of identity, value, belonging, and attachment. Similarly, meaningful roles and their provisions may help to increase older adults' ability to actively cope with late-life stressors (Glass et al., 2006). Better coping could increase self-esteem, encourage positive and supportive relationships, and improve mood (Fiori, Smith, & Antonucci, 2007).

Conceivably, certain aspects of older adults' social environment might allow them to compensate or better cope with stressful events. In addition, social networks and participating in social activities may increase older adults' opportunities for social support, social resources and social capital. At this point, very little research has been conducted on the relationship between stress, cognitive health and the socioenvironmental factors. However, there is substantial amount of literature on social support and stress (S. Cohen, Underwood, & Gottlieb, 2000) that may shed

further light on this connection. Engaging in social activities, especially enjoyable and meaningful ones, could buffer against the negative impacts of stress via several neuroendocrine processes. Some have suggested that the "pleasure-reward" system in the brain—a system that involves endorphins, dopamine, and serotonin—may have the opposite effect of allostatic load (Winwood, Bakker, & Winefield, 2007).

1.3.3 Mood

Mood disorders (depression, anxiety and apathy) are associated with an increased risk of cognitive impairment (Hendrie et al., 2006). Mood problems also predict future cognitive decline (Simard, Hudon, & van Reekum, 2009). A 12-year study examining the cognitive health of 1,256 older adults found that those with higher psychological distress were 40% more likely to experience cognitive impairment (Wilson et al., 2007). Additional studies have suggested there is a connection between depressed mood and cognitive health problems (Ganguli, Snitz, Vander Bilt, & Chang, 2009). The prevalence of depressive symptoms in older adults usually ranges from 8% to 16% (Blazer, 2003); however, in older adults with cognitive impairment, the prevalence of depression ranges from 26% to as high as 50% (Potter & Steffens, 2007). Older adults with cognitive impairment also experience more anxiety, and severe anxiety is associated with further cognitive decline (Beaudreau & O'Hara, 2008).

The precise mechanisms explaining why mood disorders in late life affect cognitive health remain uncertain. Some have suggested that mood disorders cause cerebrovascular changes and/or impact brain structures and functioning (Hendrie et al., 2006). Social networks and participation in social activities may help to improve mood. Studies have shown that

remaining socially active in late life is associated with fewer depressive symptoms over time (Glass et al., 2006; Hong, Hasche, & Bowland, 2009). Thus, remaining socially active in late life could benefit cognition by elevating mood and providing some protection from the negative effects of emotional distress. Research is needed to determine why social networks and social activity participation are associated with better mood, and what components are important for older adults' cognition health. Perhaps aspects of the social environment are important for self-esteem and mood in late life. Interventions with older adults with dementia have found that social activities, such as music and reading activities, improved self-esteem and reduced depressive symptoms in some participants (Cooke, Moyle, Shum, Harrison, & Murfield, 2010).

1.4 SUMMARY AND RESEARCH GAPS

There is evidence to support the relationship between older adults' social environment and cognitive health. However, further research is needed to better understand the social context in which relationships and activities with others may promote healthy cognitive aging. This may also help to further disentangle the mechanisms that may be involved in the link between the social environment and cognitive health in late life. First, social activities have been found to be associated with cognitive health across the lifespan, but less is known about the pattern of these relationships (social network structure). Much of the research on social networks and cognitive health has focused on whether network size is important, and there is a remaining need to explore other structural network characteristics, such density, centrality, and other measures of cohesion. A second important question involves determining what types of social activities may lead to cognitive health. Studies have found that different types of social activities are important

for cognitive health, ranging from those with close contacts to those done in formal settings, such as community center and civic activities. Finally, the purpose or reason for why older adults participate in social activities also remains unclear. Some have suggested that productive and leisure aspects are important, while others have suggested that enjoyment is important. Answering these questions can help to further understanding of how social networks and social activities may impact cognitive health.

1.4.1 What structural characteristics of networks are important for cognitive health?

It is important to better understand the role of social networks in promoting cognitive health in late life. Much of the research on social network structure has focused on network size. There have been mixed findings in regards to network size, and less is known about other structural characteristics of social networks that may influence cognitive health in late life. Several structural characteristics of networks, such as centrality, cohesion, and position in the network, may help to further elucidate the relationship between social networks and cognitive health. This also involves examining whether there are differences in structural characteristics of social networks by cognitive health. Further study could lead to a greater understanding of aspects of social networks that matter, and whether efforts aimed at promoting or improving older adults' cognitive health should consider social network interventions.

1.4.2 What specific types of social activities are most beneficial to cognitive health?

Much of the evidence for the link between social activities and cognitive health comes from studies that utilized composite scores. Very few if any have based findings from a validated

social activity measure; and typically only six to 12 items are used to represent older adults' social activity participation (James, Wilson, et al., 2011; Thomas, 2011b). It is also challenging to tease out those activities that are purely social from those that are done alone. Further, social activities are sometimes done with close ties, such as friends and family, and at other times they are done with formal groups (churches/synagogues and professional associations). Caillios (1961) work on "Man, Play and Games" suggests that activities fall into four categories, Agôn, Alea, Ilinx/Vertigo, and Mimicry. These categories may help to further characterize the types of social activities done in late-life. Thus, there is a need for research that specifically characterizes the specific types of social activities that are important for cognitive health.

1.4.3 Does the purpose of social activities matter for cognitive health?

Understanding why older adults participate in social activities is important for tailoring social activities that encourage participation and meet older adults' specific needs. Very little of the literature has explored why older adults participate in social activities; or what components of social activities may be most important for cognitive health. Rook (1987) has suggested that companionship or enjoyable social and leisure activities are important for older adults' health and well-being. Some have suggested that social activities may be beneficial because of challenge or cognitive demand (Holtzman et al., 2004; Singh-Manoux et al., 2003), while others suggest that productive or meaningful experiences (Glass et al., 2006) are most important. Perhaps the purposes of and participation in social activities in late life also differ by age, race, gender, socioeconomic status, education, and marital status. Understanding these differences could be useful to behavioral interventions attempting to replicate social activities that occur in real-world settings.

2.0 OVERVIEW OF DISSERTATION AND SPECIFIC AIMS

The purpose of this dissertation was to utilize a mixed-methods research design to better understand the relationship between cognitive health and older adults' social environments. However, our measure of cognitive health examined only one domain of cognition—episodic memory—which was assessed via the Memory Impairment Screen by telephone (MIS-T). This cognitive health outcome will be referred to from here on out as memory or memory performance. Three studies were conducted, aimed at testing the relationships between memory performance and two social-environmental factors (social networks and social activities) in a community-based sample of older adults. Participants in our studies consisted of community-dwelling older adults age 50 and older, who were recruited from senior centers across the state of Pennsylvania to participate in a study on the primary prevention of falls.

First, a prospective study (Study 1) examined the association between memory and the structural characteristics of social networks in a convenience sample of 845 community-dwelling older adults from a study on the primary prevention of falls. Second, a qualitative in-depth interview study (Study 2) explored the types of social activities, purposes for participation, and differences by memory performance. Twenty older adults from Study 1 were asked to participate in the in-depth interviews. Finally, in Study 3, we examined whether the four types of social activities identified from Study 2 were associated with memory performance. Study 3 was also a cross-sectional study, and the study population consisted of a larger sample of older adults (n =

1,735) who were participating in the parent study, a study on the primary prevention of falls study.

2.1 STUDY 1: SPECIFIC AIMS AND HYPOTHESES

Aim 1: To examine the structural characteristics of social networks by memory performance.

- Hypothesis 1.1: Social networks will be smaller for those with worse memory performance.
- Hypothesis 1.2: Social networks will be less cohesive for those with worse memory performance.
- Hypothesis 1.3: The network composition of older adults with worse memory performance will be comprised of mostly family members.

Aim 2: To assess perceived level of enjoyment by memory performance.

- Hypothesis 2.1: Perceived level of enjoyment will be lower for those with worse memory performance.

2.2 STUDY 2: SPECIFIC AIMS AND HYPOTHESES

Aim 1: To explore the types, reasons for participating, and perspectives on the potential cognitive health benefits of engaging in social activities during late life.

- Hypothesis 1.1: Several themes may emerge, including Csikszentmihaly's (1991) concept of flow (e.g., limitation of worries, sense of time is altered, sense of control, etc.); elements of companionship (egalitarian, non-productive purposes, and enjoyment); and social activities that can be categorized into four types (Caillois, 1961), such as *Agôn* - competition; *Alea* - games of chance; *Ilinx* or *Vertigo*—altering one's physical state; and *Mimicry* – creativity or the simulation of alternative realities.

2.3 STUDY 3: SPECIFIC AIMS AND HYPOTHESES

Aim 1: To examine the association between four types of activities and memory performance.

- Hypothesis 1.1: Participation in creative social activities will be associated with better memory performance.
- Hypothesis 1.1: Participation in two or more social activities will be associated with better memory performance.

Aim 2: To determine if engagement in the four types of social activities differs by participants' sociodemographic and health-related characteristics.

- Hypothesis 2.1: Higher education will be associated with greater participation in the four types of social activities.

3.0 MEMORY PERFORMANCE AND THE STRUCTURAL CHARACTERISTICS OF SOCIAL NETWORKS IN COMMUNITY-DWELLING OLDER ADULTS

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Manuscript in preparation.

3.1 ABSTRACT

Purpose: We studied the relationship between memory performance and several structural characteristics of social networks in a sample of community-dwelling older adults. Our objectives were to determine whether 1) memory performance was associated with network size, 2) memory was related to the cohesiveness of networks, and 3) change in memory performance over six months was associated with network structure.

Methods: Utilizing a prospective study design, we conducted telephone-based interviews with 845 older adults from a community-based study on the primary prevention of falls. We used the Memory Impairment Screen by telephone (MIS-T) to examine memory performance over 6 months (scored from 0 to 8; higher scores represented better memory performance). For structural network characteristics, we created an egocentric network questionnaire to collect up to eight social contacts (alters) that engaged in activities with participants (egos) over the past year. We also asked about the relationship between egos and alters, and whether each pair of alters had done activities together in the past year.

Results: Better memory performance was associated with having a larger social network ($p < 0.001$), more friends ($p < 0.01$), increased network interconnectivity ($p < 0.001$), larger groups ($p < 0.01$), and less constraint—greater potential for accessing social capital ($p < 0.01$). We also found that change in memory performance over six months was associated with most of these network structures.

Implications: Memory performance may play an important role in shaping older adults' social lives. These data provide further detail on the relationship between memory performance and social networks in late life.

3.2 INTRODUCTION

Maintaining cognitive health in late life is an important feature of healthy aging. This is becoming an increasingly important issue as we continue to see an increase in the population of adults age 65 years or older. Cognitive health has been defined as being able to perform all of the mental processes that are collectively known as cognition, which includes memory, language, attention, judgment, executive function, judgment, as well as the ability to lead a purposeful life (CDC, 2011). Maintaining cognitive health is also an important public health concern with relevance to reducing health-care costs, institutionalization, and caregiver burden (Hughes & Ganguli, 2009).

Numerous studies have shown a connection between cognitive health and various aspects of older adults' social environments—including social networks, social support, and social activities (Bennett, Schneider, Tang, Arnold, & Wilson, 2006; Hughes, Andel, Small, Borenstein, & Mortimer, 2008; James, Wilson, et al., 2011; Pillai & Verghese, 2009). Several studies have found that network size (having a smaller number of ties or having no connections) was related to different cognitive health outcomes (Bassuk et al., 1999; Fratiglioni et al., 2000), and this relationship has been confirmed in several longitudinal studies (Barnes, Mendes de Leon, Wilson, Bienias, & Evans, 2004; Holtzman et al., 2004). However, very few studies provide much detail on network size differences. Some report networks of older adults being as small as two, and others have suggested that networks are as large as seven (Beaudreau & O'Hara, 2008; B. Cornwell et al., 2008).

Social network size has not always been found to be associated with cognitive health. For instance, Amieva et al. (2010) found that other features of social networks (satisfaction and reciprocity among ties) predicted older adults' risks of dementia over 5 to 15 years. Other longitudinal studies have shown that network size was not related to risks of cognitive decline (Green, Rebok, & Lyketsos, 2008; Stoykova, Matharan, Dartigues, & Amieva, 2011). The variability in findings across studies may be due to how social networks have been assessed. Different measures have been used to represent social networks, such as marital status, number of confidants, access to social support, closeness, and even living arrangements (Seeman, Lusignolo, Albert, & Berkman, 2001; Zunzunegui et al., 2003). Assessing networks in these different ways most likely impacts the external validity of these studies, and may under- or overestimate the relationship between social networks and cognitive health.

Social networks are defined as the web of social ties that connect people to one another, and networks are typically assessed in one of two ways. Egocentric networks (personal or local networks) examine dyadic relationships or ties between the ego (respondent) and his/her social contacts (alters) (Smith & Christakis, 2008; Valente, 2010). Another way to assess networks is to examine sociocentric networks (sociometric or complete networks), which attempts to collect all of the ties among a specific group or population. Sociocentric networks are difficult and time consuming to collect because they require interviewing the ego and all of his/her named alters (Flatt, Agimi, & Albert, 2012). Because of these limitations, network elicitations tend to use an egocentric approach.

There is also a need to go beyond examining basic network structures like size. Current research on networks and health has suggested that other structural characteristics of networks should be considered (Valente, 2010). Structural characteristics of networks—density,

composition, centrality, and measures of cohesiveness (Berkman & Glass, 2000; Rook, 1994; Valente, 2010)—could help to further explain how networks may be important for cognitive health in late life.

Diameter can be used to examine the distance between ties in a network, while looking at the composition helps to identify relationship types (friends, family, etc.) in a network. Other structural characteristics examine cohesiveness or the level of interconnectivity in a network, such as degree centrality, betweenness centrality, density and average path length. Degree centrality examines the number of links to and from a person, while betweenness centrality examines the distance between alters (Valente, 2010). Density is used to examine network connectedness by comparing the number of ties in a network to all of the possible ties. Average path length looks at the average distance among all network members (Valente, 2010).

Network structure can also be examined for clustering or subgroups. A clustering coefficient can help with identifying "pockets of interconnectivity" (Valente, 2010). To examine groups or networks within networks, researchers can look at clique size or the number of connections. Examining the position of the ego in the network is also important. Constraint determines whether an ego spans a structural hole in his/her network (Burton, Wu, & Prybutok, 2010; Hanneman & M., 2005). Structural holes are created in a network when alters are not connected to one another; these unconnected alters are often considered to be weak ties (Burt, 2001). When an ego spans a structural hole, they may be able to control the flow of resources and have greater levels of social capital (access to novel information and resources).

There has also been quite a bit of variability in how cognitive health outcomes have been assessed across studies. Cognitive health outcomes have included memory, risks for Alzheimer's (AD) and dementia, the presence of AD pathology, and cognitive decline over time. Several

studies, however, have suggested that there are consistent patterns of associations between various cognitive domains (memory, language, attention, etc.) and social networks (Hughes et al., 2008; Seeman et al., 2001).

A recent study examined the relationship between social networks and episodic memory over 15 years (Giles, Anstey, Walker, & Luszcz, 2012). Episodic memory or the ability to learn and recall new information (Petersen et al., 1997; Plancher et al., 2012) is often impaired in older adults with cognitive health problems, and may indicate an early manifestation of AD (Lipton et al., 2003). Giles and colleagues (2012) determined that network size and composition (having more friends) were related to better episodic memory performance; however, they did not look at other structural characteristics of networks that could have been important.

The purpose of our study was to examine the associations between memory performance (episodic memory) and various social network structural characteristics in a community-based sample of older adults. The specific aims of this study were to 1) describe the structural characteristics of networks, 2) determine whether there was an association between memory performance and various network structural characteristics**,** and 3) examine whether there was an association between change in memory performance over six months and the various network structural characteristics. We hypothesized that worse memory performance would be associated with having a smaller and less cohesive network, a network composed of mostly family members, and rating interactions with network contacts as less enjoyable.

3.3 METHODS

3.3.1 Design

This prospective study is a substudy of two comparative effectiveness studies, Falls-Free PA and Falls Risk by Exposure (FARE), both examining the primary prevention of falls among older adults in Pennsylvania. Inclusion criteria for the studies were: 1) being a community-dwelling resident of Pennsylvania, 2) being age 50 or older, 3) not having a decisional impairment (severe cognitive impairment or dementia), 4) not having a life-threatening illness, and 5) not planning to move in the next 12 months. A total of 2,026 participants were recruited from senior centers and senior high-rise apartments in Pennsylvania between November 2010 and August 2012. The primary studies made brief monthly contacts with participants via telephone, and participants completed a 15 to 25-minute structured telephone interview every six months. These interviews assessed falls risk, as well as sociodemographic characteristics, memory performance, and other health-related factors. These studies were approved by the University of Pittsburgh Institutional Review Board.

Our substudy was conducted from June to December 2012, and the available sample consisted of 1,056 participants who were due for a final interview. During the final interview, participants were asked to complete the falls risk assessment as well as our brief social network questionnaire (see appendix 1). The network questionnaire took approximately 5 to 10 minutes to complete, and it was administered after the falls risk assessment.

3.3.2 Measures

Sociodemographic factors included age in years (continuous), gender, education level (less than high school, high school or equivalent [GED], some college, and college graduate), marital status (single, married, divorced/separated, and widowed), living arrangements (alone vs. with others), and race (white, African American, other). Additional health-related covariates were examined because of their potential association with social networks and/or cognition including mobility impairment (no problems vs. some or a lot), self-rated health (scores ranging from 0 – 100), and number of comorbidities, which included heart disease, depression and anxiety, arthritis and other chronic conditions.

We used the Memory Impairment Screen for telephone (MIS-T), a brief four-item assessment validated for assessing episodic memory performance in community-based samples (Buschke et al., 1999; Lipton et al., 2003). This assessment was collected twice, about six months apart. Participants were asked to repeat four words, identify a semantic category (cue) for each word, and then recall the words after a short interference period (3 to 4 minutes). Freely recalled words receive two points and cue recalled words receive one point. Scores ranged from 0 to 8 (with higher scores suggesting better memory performance), and a cutoff score of 4 or less may indicate possible memory impairment and/or dementia. This is memory assessment has been validated in previous studies and with community-based samples (Kuslansky et al., 2002; Lipton et al., 2003); and the MIS-T is considered to have good alternate forms reliability, high construct validity, and good discriminative validity (i.e., sensitivity, specificity, and positive predictive values).

Based on the assumption that participation in social activities is associated with better cognitive health in late life (Carstensen & Hartel, 2006; Plassman, Williams, Burke, Holsinger,

& Benjamin, 2010), we developed a social network questionnaire to identify alters that engaged in social activities with the ego over the past year. We constructed the survey by modifying an instrument used by the National Social Life, Health and Aging Project (NSHAP), a longitudinal, population-based study on the health and social factors of community-dwelling older adults ages 57 to 85 (B. Cornwell, Schumm, Laumann, & Graber, 2009). Our network questionnaire was only administered during the final interview.

Based on an egocentric approach, we used a name-generating technique to elicit up to eight alters with whom egos did activities over the past year; this was used to calculate network size. To examine network composition, egos were asked to report on alter relations (friends, family, acquaintances or other). Enjoyment consisted of how much egos enjoyed doing activities with alters; this was based on a scale of 1 to 10, with 1 being not all and 10 being very much. Because egos often reported the top score (10) for all ties, enjoyment was computed by calculating the proportion of the network with an enjoyment score of 10.

Finally, egos were asked about whether his/her alters had done activities with one another over the past year. This resulted in a maximum of 28 ties among alters, and data were used to compute several measures to further describe the social network structure. Several structural characteristics of the network were computed based on the data collected on ties among all of the network nodes ("nodes" includes ties to both the ego and all of the alters). Density was computed by dividing the number of ties by all possible ties in the egocentric network (Valente, 2010). Diameter was based on the longest path (maximum distance) between the nodes. Average path length was based on the average distance between all nodes in the network. In egocentric networks, average degree—considered a centrality measure—was computed by averaging the number of ties to and from all nodes in the network. Another

centrality measure, betweenness, was calculated by counting the number of shortest paths connecting all of the nodes in the network. Clustering coefficient, a way to examine "pockets of interconnectivity," was measured by taking into account the number of closed clusters (defined as three connected nodes not connected with others) by the total number of clusters (closed, as well as open clusters or those connected with others). Largest clique size was computed by counting the largest subgroup or the number of interconnected nodes. Finally, constraint (a measure of structural holes) was based on the position of the ego, and computed by examining the extent to which an alter has ties to other alters that already have ties to others.

3.3.3 Data Analysis

All statistical analyses were conducted in SPSS version 18, and network measures were computed in igraph (Csárdi & Nepusz, 2006). Multiple linear regression was used to examine the extent to which memory performance was related to each of the structural social network measures. No adjustments were made for multiple comparisons because of the exploratory nature of this study. Potential confounding factors were identified by examining bivariate correlations between sociodemographic/health-related variables and memory performance and structural network measures, respectively. Confounders were included in the adjusted regression models if they met our definition of confounding, associated ($p < 0.10$) with both memory performance (predictor) and structural characteristics of the social networks (outcomes). To identify the unique contribution of memory performance in predicting the network characteristics, hierarchical linear regression were then used with the identified confounders entered into Step 1 and the memory performance entered into Step 2.

To examine change in memory performance, we calculated the residualized change score (Campbell & Kenney, 1999); this adjusts for baseline performance and has been used by other studies examining the relationship between social networks and change in cognitive health outcomes (Seeman et al., 2001). The residualized change score was then tested in regression models to examine whether change in memory performance was associated with the structural network measures.

3.4 RESULTS

Participant sociodemographic characteristics are presented in Table 2. The sample (N = 845) had a mean age of 76 (ranging from 52 to 95) and was mostly female. The majority of participants were Caucasian and about 8% were African American. Close to 40% of participants reported education beyond high school. Forty-three percent were widowed and about 50% lived alone. Seventeen percent of participants reported mobility problems, on average participants had three chronic conditions. Average self-rated health was relatively high, at greater than 80. The mean score for memory performance was 7.0 at baseline and six months. Utilizing the recommended cutoff score of ≤ 4 (Buschke, et al., 1999), 4% of participants (N = 34) at baseline and 6% of participants (N = 51) after 6 months were considered to have possible memory impairment and/or dementia. We found that the average network size was 6.0 ± 2.0 social contacts, and networks were comprised of mostly friends followed by family members, acquaintances and others, respectively. Networks were relatively dense, and the largest subgroup was 5.0 ± 1.7 social contacts.

Table 2. Sociodemographic, health and social network characteristics, n=845

Characteristic	Value	Characteristic	Value
Age, mean (SD)	75.5 (8.7)	**Memory performance**	
Gender, %		Baseline[a], mean (SD)	7.0 (1.3)
Female	80.8	Baseline score ≤ 4, %	4.0
Male	19.2	Six Months, mean (SD)	7.0 (1.6)
Race, %		Six Months score ≤ 4, %	6.0
Caucasian	89.5	**Network Size**, mean (SD)	6.05 (2.04)
African American	7.5	**Composition**, mean (SD)	
Other	3.0	Family	2.13 (2.02)
Education, %		Friends	3.70 (2.36)
<High School	12.4	Acquaintances	0.16 (0.80)
High school/GED	48.5	Other	0.05 (0.41)
Some college	22.4	**Enjoyment**, mean (SD)	0.68 (0.36)
College graduate	16.7	**Network Structure**, mean (SD)	
Marital status, %		Density	0.75 (0.20)
Single	10.0	Average path length	1.25 (0.20)
Married	36.8	Diameter	1.79 (0.41)
Divorced/Separated	10.7	Average degree centrality	4.40 (1.82)
Widowed	42.5	Betweenness centrality	5.01 (5.97)
Live alone, %	48.8	Clustering coefficient	0.62 (0.32)
Mobility problems, %	16.7	Largest clique size	5.07 (1.71)
Self-rated health, mean (SD)	82.2 (14.3)	Constraint	0.52 (0.19)
Comorbidities, mean (SD)	2.79 (1.7)		

[a]15 respondents did not complete the baseline assessment. The majority (87%) of those with missing scores scored a 6 or higher at six month follow up.

3.4.1 Memory Performance and Network Structures

Next we examined the bivariate correlation between sociodemographic and health variables with memory performance and network structures (Table 3). Identified confounders ($p \leq 0.10$) included several sociodemographic (age, gender, race, marital status, and education) and health variables (self-rated health state and mobility impairment). Based on bivariate associations, memory performance was related to overall network size, number of friends, number of family members, diameter, average degree centrality, betweenness centrality, largest clique size, constraint, and enjoyment. Memory performance was not associated with density, average path length, and the clustering coefficient.

We then tested the associations in multivariate regression models and adjusted for the identified confounders. Several confounders were significantly correlated, but diagnostic tests in our regression analyses suggested that the collinearity assumption was not violated, since the variance inflation factor (VIF) was less than 2.12. After adjusting for identified confounders in multivariate regression models, memory performance was no longer associated with number of family members, betweenness centrality, and enjoyment.

Based on hierarchical regression models (Table 4), we found support for our hypothesis that memory performance was related to network size ($\beta = 0.15$, $p < 0.001$), and that networks were smaller for those with worse memory performance. However, memory performance only contributed an additional 2% of variance after adjusting for confounders. With regards to our hypothesis on cohesiveness, our results suggested that memory performance was positively associated with average degree centrality ($\beta = 0.13$, $p < 0.001$), which represents greater network interconnectivity. The results also indicated that memory performance was positively associated

with largest clique size ($\beta = 0.12$, $p < 0.01$). Lastly, we found that memory performance was negatively associated with constraint ($\beta = -0.12$, $p < 0.01$), our measure of structural holes. We did not find support for our hypothesis that worse memory performance would be associated with having a greater number of family members than friends. However, we did find that memory performance was positively associated with number of friends ($\beta = 0.10$, $p < 0.01$); suggesting that those with worse memory performance had fewer friends.

There were some additional findings in regards to the relationship between network structure and our confounders. With regards to marital status, participants that reported being single were more likely to have smaller networks ($\beta = -0.12$, $p < 0.01$), less average degree centrality ($\beta = -0.16$, $p < 0.001$), and smaller clique size ($\beta = -0.13$, $p < 0.001$). While age was not related to network size, it was positively related to number of friends ($\beta = 0.11$, $p < 0.01$). Education was also related to network size and number of friends in that those with less than a high school education had smaller networks ($\beta = -0.11$, $p < 0.01$) and fewer friends ($\beta = -0.12$, $p < 0.01$). Finally, female participants were more likely to have larger networks ($\beta = 0.08$, $p < 0.05$) and less constraint ($\beta = -0.11$, $p < 0.01$).

Table 3. Correlation between social network characteristics, memory and sociodemographic variables

Variable	Memory	Size	Density	Avg. degree	Avg. path length	Diameter	Betweenness	Clust. coef	Largest clique size	Constraint	No. Family	No. Friends	Enjoy
Memory	1.00	0.17***	-0.05	0.12***	0.05	0.11***	0.06*	0.01	0.10***	-0.14***	0.08**	0.06*	0.07*
Age	-0.21***	-0.05	0.00	-0.05	0.00	-0.04	0.00	-0.05	-0.04	0.01	-0.15***	0.07**	-0.04
Live alone	0.00	-0.08**	0.04	-0.06	-0.04	-0.10***	0.00	0.03	-0.04	0.06	-0.18***	0.09**	-0.04
Gender													
Female	0.07**	0.07**	-0.11**	0.00	0.11**	0.15***	0.10***	-0.10***	0.01	-0.11***	0.04	0.05	0.14***
Race/ethnicity													
White	0.06*	0.03	-0.01	0.01	0.01	0.00	0.01	0.01	0.02	-0.00	0.02	0.04	-0.01
AA	-0.06*	-0.04	0.01	-0.01	-0.01	0.01	-0.03	-0.02	-0.02	-0.01	-0.02	-0.02	-0.00
Other	-0.02	0.01	-0.00	-0.01	-0.00	-0.03	0.04	0.00	0.01	0.00	-0.02	-0.02	0.01
Marital status													
Single	-0.02	-0.09***	-0.05	-0.12***	0.05	-0.01	0.03	-0.09***	-0.11***	0.02	-0.08**	-0.01	-0.07**
Married	0.06*	0.12***	0.05	0.13***	-0.05	0.03	-0.05	0.07**	0.11***	-0.04	0.15***	-0.02	0.02
Sep./Divorced	0.01	-0.05	0.00	-0.05	0.00	-0.01	-0.01	0.01	-0.04	0.04	-0.02	-0.02	-0.01
Widowed	-0.06	-0.02	-0.02	-0.03	0.02	-0.01	0.0	-0.02	-0.02	-0.00	-0.08**	0.05	0.04
Education													
< HS	-0.09**	-0.11***	-0.03	-0.11***	0.03	-0.01	-0.00	-0.06	-0.10***	0.06*	-0.02	-0.08**	-0.00
HS	-0.02	-0.01	0.04	0.03	-0.04	-0.05	-0.03	0.04	0.04	-0.00	0.02	-0.01	-0.01
Some college	0.04	0.03	0.02	0.04	-0.02	0.04	-0.01	0.02	0.03	0.00	0.03	0.01	0.02
College grad	0.05	0.07**	-0.04	0.02	0.04	0.02	0.06	-0.02	0.02	-0.04	-0.02	0.07**	-0.02
Self-rated health	0.09***	0.10***	-0.01	0.08**	0.01	0.03	0.03	0.03	0.07**	-0.05	0.01	0.07**	-0.05
Comorbidities	-0.00	-0.03	-0.01	-0.03	0.01	0.00	0.01	-0.02	-0.03	0.00	0.01	-0.02	-0.03
Mobility impair.	-0.06*	-0.08**	0.02	-0.06*	-0.02	-0.05	-0.01	-0.01	-0.06*	0.06*	-0.03	-0.06*	-0.03

*p<.10; **p<.05; ***p<.01

Table 4. Results of hierarchical regression analyses: the association between structural network characteristics and memory performance

Variable	Size		Number of Friends		Average Degree		Largest Clique Size		Constraint	
	Model 1 β	Model 2 β	Model 1 β	Model 2 β	Model 1 β	Model 2 β	Model 1 β	Model 2 β	Model 1 β	Model 2 β
Step 1										
Age	-0.04	-0.00	0.08*	0.11**	-0.04	-0.01	-0.04	-0.01	-0.00	-0.03
Gender (ref. Male)	0.08*	0.07*	0.04	0.03	0.01	-0.00	0.01	0.00	-0.12**	-0.11**
Marital status (ref. Married)										
Single	-0.13**	-0.12**	-0.01	0.00	-0.16***	-0.15***	-0.14***	-0.13***	0.03	0.03
Sep./Divorced	-0.08*	-0.08*	0.01	0.01	-0.09*	-0.08*	-0.06	-0.06	0.04	0.04
Widowed	-0.06	-0.07	0.03	0.02	-0.08	-0.08	-0.06	-0.06	0.03	0.03
Education (ref. College grad)										
Less than HS	-0.12**	-0.11**	-0.13**	-0.12**	-0.09*	-0.08	-0.08	-0.07	0.08	0.07
HS grad or GED	-0.08	-0.08	-0.11*	-0.11*	-0.00	0.00	0.01	0.01	0.07	0.07
Some College	-0.04	-0.04	-0.07	-0.07	0.01	0.01	0.01	0.01	0.06	0.06
Self-rated health	0.06	0.05	0.06	0.05	0.05	0.04	0.04	0.03	-0.02	-0.01
Impaired mobility (Ref. No)	-0.02	-0.02	-0.03	-0.03	-0.02	-0.02	-0.02	-0.02	0.04	0.04
Step 2										
Memory performance		0.15***		0.10**		0.13***		0.12**		-0.12**
ΔR^2		0.02		0.01		0.02		0.01		0.01
F for ΔR^2		18.64***		7.29**		12.70***		10.48**		11.22**
Overall R^2	0.05	0.07	0.02	0.03	0.04	0.06	0.03	0.05	0.02	0.03
Overall F	3.27***	5.26***	2.02*	2.52**	3.60***	4.48***	2.75**	3.48***	1.77	2.65**

Note: Entries represent standardized coefficient estimates; * $p < 0.05$; ** $p < 0.01$, *** $p < 0.001$

3.4.2 Change in Memory Performance and Network Structures

Change in memory over six months was very small (0.01, SD = 1.44; a range of -7.49 to 4.12). About 15% of the sample's memory score declined, and close to 7% improved over six months; these percentage rates were based on residualized change scores that were plus or minus one standard deviation from the mean. After adjusting for previously identified confounders (Table 5), change in memory performance was associated with network size ($\beta = 0.12$, $p < 0.01$), average degree ($\beta = 0.09$, $p < 0.01$), largest clique size ($\beta = 0.09$, $p < 0.05$), and constraint ($\beta = -0.10$, $p < 0.01$). Change in memory performance was marginally associated with the number of friends ($\beta = 0.07$, $p = 0.05$).

Table 5. Association between change in memory performance over six months and network structures

Variable	Size β	Number of Friends β	Average Degree β	Largest Clique Size β	Constraint β
Change in memory performance	0.12**	0.07	0.09*	0.09*	-0.10**

Model adjusted for age, gender, marital status, education, self-rated health, and mobility impairment; * $p < 0.05$; ** $p < 0.01$

3.5 DISCUSSION

Our findings demonstrated that there was a cross-sectional association between memory performance and five structural network variables (network size, number of friends, average degree centrality, largest clique size, and constraint) in our community-based sample of older adults. Our findings on network size and number of friends were similar to those found by Giles and colleagues (2012), who examined memory performance over 15 years. The associations between memory performance and network structures remained even after examining change in memory performance over six months, and after controlling for potential confounders. However, we did not find an association between memory performance and several structural network characteristics, such as betweenness centrality, density, diameter, average path length, and clustering coefficient.

Examining the MIS-T cutoff score, older adults with worse memory performance (MIS-T ≤ 4) had about two fewer social contacts, one less friend, one less person in their largest group (largest clique size), and about 11% more constraint. In Figure 4, we depict how the level of network constraint differs by memory performance cutoff scores. Those with better memory performance (MIS-T ≥ 5) were more likely to span a structural hole compared to those with a worse memory performance (MIS-T ≤ 4), ($t= -3.22$, $p < 0.01$).

Our findings also suggest that network structure differs by several sociodemographic characteristics. Compared to males, females had larger networks and less constraint; and being married was also associated with having a larger network. In line with other network studies (Fiori, Antonucci, & Cortina, 2006; Moore et al., 2011), we found that higher educational attainment was associated with having larger networks and more friends.

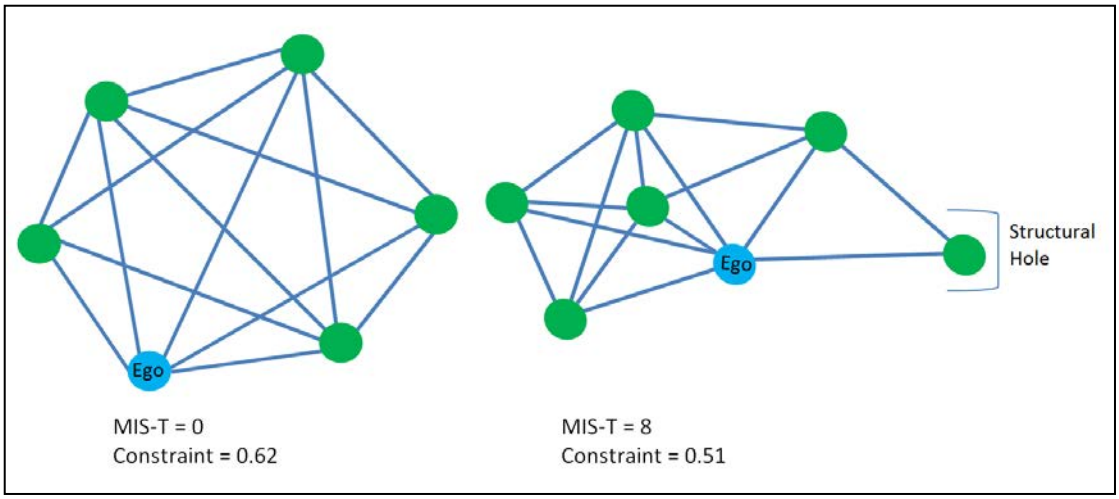

Figure 4. Visualization of network constraint by MIS-T cutoff scores

There are several possible explanations for the associations we found between memory performance and several structural characteristics of social network. It has been suggested that several psychological and biological mechanisms may help to explain the relationship between social networks and health (Berkman & Glass, 2000; Glanz, Rimer, & Viswanath, 2008). Considering possible psychological mechanisms within the context of aging, the Socioemotional Selectivity Theory suggests that emotional closeness becomes more important in later life (Lang, Staudinger, & Carstensen, 1998). Carstensen (1992) has found that older adults encounter a shift in priorities with life goals (long-term) becoming less important and a greater attention to emotionally-oriented goals (short-term) getting greater attention. It has been suggested that this shift could increase older adults' ability to adapt to emotional distress and regulate affect (Carstensen, 1992; Charles & Carstensen, 2010).

Our findings on network structure may provide support for the protective effects of emotional closeness on memory in late life. We found that older adults with better memory performance had more friends and a larger number of connected alters, which was supported by

our findings on greater average degree centrality and larger groups (larger clique size). Having a more interconnected network could provide older adults with greater access to social support, which may buffer against stress and improve psychological, physical (S. Cohen, 2004), and cognitive health (Seeman et al., 2001).

It has also been suggested that connected or cohesive groups are healthier, and these groups may provide opportunities for social capital (Bruhn, 2009). Social capital has been defined as a potential network resource that includes access to emotional support, healthcare advice and health information, social activities, and financial resources (Ajrouch, Antonucci, & Janevic, 2001; Valente, 2010). Several studies have found a relationship between social capital and longevity and better health (Islam, Merlo, Kawachi, Lindstrom, & Gerdtham, 2006).

Access to social capital may also be impacted by the level of constraint in networks. We found that those with better memory performance were more likely to have less network constraint. Building off Granovetter's theory on the strength of weak ties, having less network constraint or spanning structural holes may offer increased access to information and novel resources (Burt, 2001; Granovetter, 1973). For instance, a recent study demonstrated that those with worse health and cognition (measured by the Short Portable Mental Status Questionnaire) were less likely to span structural holes (B. Cornwell, 2009). Perhaps having greater access to social capital is important for maintaining cognitive health, especially memory, in later life. Perhaps social contacts provide and share various resources, such as information and other forms of social support, which are important for maintaining cognitive health in late life.

Others have suggested that there may be a more direct pathway linking social networks to health. From a physiological perspective, studies have demonstrated that there is a relationship between larger networks and reduced risk of cognitive decline in late life (Crooks et al., 2008;

Giles et al., 2012; Holtzman et al., 2004). Further, a study found that larger social networks reduced the effects of Alzheimer's disease pathology on cognitive abilities in late life (Bennett et al., 2006). It has been suggested that networks may improve brain health by providing greater opportunities for cognitive stimulation. Much of the research on social engagement or social activities provides support for this mechanism (Carstensen & Hartel, 2006; Krueger et al., 2009). Our elicitation of social networks was meant to capture social contacts who did activities with respondents. Perhaps our finding that memory performance was related to network size indicates how social activities could be important for cognitive health in late life. It has also been posited that social networks could influence health by reducing other physiological vulnerabilities (cardiovascular disease, stress, and depression) that are related to memory problems in late life. We found that self-rated health and mobility were associated with several of the structural network measures; perhaps this supports another pathway by which networks may affect overall health, as well as memory and cognitive health.

There are several limitations of our study that must be discussed. First, analyses were based on self-reported social network variables and other characteristics that were collected at baseline. It is plausible that individuals with memory deficits may not have recalled all social contacts or previous declines in memory led to changes in social networks. Further, social withdrawal and/or social exclusion may be prodromes of memory problems in late life. Second, our findings should be interpreted in light of our study's cross-sectional design and measurement limitations. Our social network measure was only collected during the six-month follow-up, and we had no way of assessing changes in social networks. However, studies have suggested that older adults' social networks remain relatively stable over several years (Martire, Schulz, Mittelmark, & Newsom, 1999; Tilburg, 1998). While we did examine change in memory

performance over six months, it may not have provided enough time to detect notable changes in memory. In addition, our measure of memory performance had several weaknesses in that it only measured episodic memory, was assessed by telephone (which could have resulted in lower memory scores for those with hearing impairments); also individuals with possible dementia/decisional impairment were excluded from our study. Yet it should not be overlooked that this screening tool for dementia is commonly used, and we were still able to find notable differences in our community-based sample. Nonetheless, using a broader measure of cognitive health could improve our study, and further understanding of the relationship between cognitive health and structural characteristics of networks is needed.

These limitations are balanced by several strengths in our study. First, several structural measures of social networks were considered; and most studies on social networks and health in late life have not examined these structural characteristics. Specifically, we could not identify any other studies that have examined how cognitive health outcomes, including memory, were associated with average degree, largest clique size, and our measure of constraint. Second, our network questionnaire was designed to identify the specific social ties that may be most important for older adults' cognitive health and memory. Finally, we collected rich data on demographic factors, which were adjusted for in our analyses, from our community-based sample that was diverse (10% minorities), varied in age, and included older adults from a range of educational backgrounds, and from both rural and urban community-settings.

In summary, we have shown that memory performance was related to several structural network characteristics in our prospective study of community-dwelling older adults. We also found that these associations persisted when looking at change in memory over six months. These associations were independent of several sociodemographic and health-related factors.

Memory performance seems to be an important factor associated with older adults' social lives, and may have important implications for accessing available social capital and social support.

4.0 THE PHILOSOPHY OF SOCIAL ACTIVITIES IN LATE LIFE: EXPLORING POTENTIAL BENEFITS FOR COGNITIVE HEALTH

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Manuscript in Progress.

4.1 ABSTRACT

Purpose: Participating in social activities has been shown to be positively associated with cognitive health in late life. However, few studies have looked at older adults' subjective views on participating in social activities, which could shed light on cognitive health. This qualitative study examines the types of social activities that may be important for cognitive health in late life. Further, we identified the purposes of engaging in social activities, and how older adults' experiences may be impacted by current memory performance.

Design and Methods: Face-to-face in-depth interviews were conducted with a purposive sample of 20 older adults, with low (n = 10) and high (n = 10) memory performance. We used grounded theory methods to analyze the narrative data.

Results: We identified four types of social activities—Altruism, Creativity, Game, and Motion—that represented the different social activities done in late life. Participants' accounts suggested that the purposes of social activity participation included enjoyment, relaxation, stimulation, and belongingness; these factors may have important implications to cognitive health in later life. Older adults in the low memory group also seemed to face more barriers to participation in social activities, such as social withdrawal, health problems and social isolation.

Implications: Future research should consider how different types of social activities may be important for cognitive health. A greater understanding may aid in developing programs that keep older adults engaged in social activities that promote cognitive health and well-being.

4.2 INTRODUCTION

With the number of older adults growing in America and around the world, an important concern in later life involves maintaining cognitive health. Cognitive health has been defined as a continuum of cognitive function ranging from cognitive decline to impairment and dementia (Lee et al., 2010). Further, cognitive health involves being able to perform all of the mental processes that are collectively known as cognition—memory, language, attention, judgment, and executive function (CDC, 2011). While some changes to cognitive health are a normal part of aging, a decline that impacts older adults' everyday functioning and independence is not normal. Declining cognitive health is detrimental to the lives of older adults and their loved ones, which is reflected by increasing health care costs, risks of institutionalization, and caregiver burden (Hughes & Ganguli, 2009).

While there are no clinically proven therapies for maintaining cognitive health, one area of research has focused on how participation in social activities may be important for cognitive health. Numerous population-based studies have found a connection between participating in social activities during later life and better cognitive health (Barnes et al., 2004; Bassuk et al., 1999; Bennett et al., 2005; Fratiglioni, Paillard-Borg, & Winblad, 2004; James, Boyle, Buchman, & Bennett, 2011; Singh-Manoux et al., 2003; Wang, Karp, Winblad, & Fratiglioni, 2002). More recent studies have shown that greater participation in social activities was positively associated with a range of cognitive health outcomes, including less cognitive decline (James, Wilson, et al., 2011; Wang et al., 2013), decreased risks of cognitive impairment (Geda et al., 2011; Hughes et al., 2012), and reduced risks of dementia (Paillard-Borg et al., 2012)

The purpose of social activity participation is unclear, and less is known about whether the purpose matters for older adults' cognitive health. Engaging in social activities in late life may offer various provisions that could be important. Social activities fulfill a broad range of goals, including leisure, enjoyment, and productivity (Glass et al., 1999). Some have suggested that older adults' cognitive health may benefit from the level of cognitive effort involved (Singh-Manoux, Richards, & Marmot, 2003), the reinforcement of meaningful social roles (Glass et al., 2006), the level of enjoyment provided (Rook, 1987), and/or the opportunities for self-expression (Pitkala et al., 2011).

It is challenging to identify the key aspects of social activities that may be important, but perhaps a multidisciplinary lens can shed further light on these important facets. From the fields of education and gerontology, Havighurst's "activity theory of aging" states that activities are important for equilibrium, adaptation to role loss, and life satisfaction (Atchley, 2006). From social psychology, Mannell (1993) has identified unique elements of social activities—opportunities for investing time and energy, a lack of obligation, and experiencing a flow state. Work in positive psychology by Csikszentmihaly (1991) suggested that a flow state involves an optimal or highly enjoyable experience where individuals can become highly immersed in the activity. Csikszentmihaly identified several key elements of a flow state, such as balance between challenge and skill, deep concentration, a minimization of worries and frustrations, and an autotelic experience or done simply for enjoyment. Finally, from philosophy and sociology, Roger Caillois studied the purpose of play and games in society (Caillois, 1961). He depicted play as free (a diversion that is enjoyable and attractive); separate (not a part of everyday life); uncertain (outcomes are not predetermined); unproductive (no goods, wealth, or new elements are created); governed by rules (order is established by laws); and finally; make-believe (another

reality is created). These multidisciplinary perspectives have not been considered when characterizing the aspects of social activities in late life that could be important, or how these aspects could be facilitative of cognitive health.

Less is known about the types of social activities that may be important for cognitive health. The majority of the research on the relationship between social activities and cognition in late-life has utilized composite scores. However, Caillois (1961) identified specific categories of activities based on the type of skill or experience involved. *Agôn* represented activities that encompass elements of competition (sports or other types of games). *Alea* involved games of chance (e.g., playing bingo or going to casinos). *Ilinx* or *Vertigo* entailed activities that alter one's consciousness (e.g., riding a merry-go round or skydiving). Finally, *Mimicry* involved activities that create new worlds or simulate alternative realities (e.g., dance, theaters, and the arts in general). Some activities fall into multiple categories. For instance, a game could involve competition and chance (e.g., golf, card games, etc.), or simulation and altering of one's consciousness (e.g., theme parks or traveling). Relatively few studies have explored the different types of social activities that older adults participate in late life, or how participation in these different social activities could be important for cognitive health.

Different types of social activities could offer unique cognitive health benefits. Further study is needed, and greater understanding could aid caregivers and health practitioners in developing programs that keep older adults better engaged in social activities that are beneficial to cognitive health. Given this gap in knowledge, we conducted an in-depth investigation of older adults' perspectives on social activities in late life and potential benefits for cognitive health. The aims of our study were: 1) to explore the types of social activities, 2) to identify purposes or reasons for why older adults participate in social activities; and 3) to compare their

experiences by memory performance in order to identify potential differences. This article focuses on older adults' responses to open-ended questions on the types and purposes of social activities in late life, and how these aspects may be relevant to cognitive health in late life.

4.3 METHODS

4.3.1 Design

We conducted a qualitative in-depth interview study with older adults from different neighborhoods in Allegheny County from June to September 2012. Participants were recruited from a community-based study on the primary prevention of falls. Our initial eligibility criteria for the study included living within the vicinity of the Allegheny County, being within the age range of 50 or older, speaking English, and completing the Memory Impairment Screen for telephone (MIS-T). During a telephone interview with the larger community-based study, eligible participants signified their interest by agreeing to allow the Principal Investigator to contact them. A purposive sampling strategy was used to recruit 10 individuals with a low memory score and 10 with a high memory score. The MIS-T is a brief four-item assessment validated for screening episodic memory performance in community-based samples (Buschke et al., 1999; Lipton et al., 2003). Scores on the MIS-T range from 0 to 8 (higher scores suggest better memory performance), and Buschke et al. (1999) have suggested that a score of 4 or 5 may indicate possible memory impairment and/or dementia. Because of the limited availability of eligible participants with a score of 5 or less, the low memory group scores ranged from 0 to 6, and a score of 7 or 8 was used for our high memory group. We also made efforts to recruit

minorities and men since studies have suggested that there could be differences in social activity participation for these groups (Zunzunegui et al., 2003).

4.3.2 Procedure

With the approval of the University of Pittsburgh Institutional Review Board, eligible participants were contacted by telephone, and interviews were scheduled at the convenience of the participant. In order to create a comfortable environment, all of the interviews were conducted in-person at participants' homes or another agreed upon site (e.g., local restaurant, public park, and library) by the Principal Investigator. Prior to starting the interview, the interviewer obtained verbal informed consent and reviewed the measures in place to protect confidentiality. The interview lasted about 68 minutes on average, with a range of 45 to 125 minutes. All of the participants agreed to be audiotaped, and participants were provided with $20.00 as compensation for their participation.

A semi-structured, open-ended interview guide was used to encourage participants to provide a personal narrative on their experiences with and views on the role of social activities in late life. A grand tour question (tell me about where you grew up, your family, your career, etc.) was used to develop rapport and obtain a brief life history from each participant. Subsequent questions were asked about the different types of social activities they participate in, barriers and motivators to participation, and aspects of social activities that may be important for cognitive health. To close the interview, we asked participants to answer a scenario question: "Imagine you could spend a day doing anything you wanted. Money, time, and health are no object. How would you spend your day?"

4.3.3 Analysis

All of the interviews were transcribed verbatim, and all personal information was transcribed in a way that maintained participants' anonymity. Grounded theory methods (Glaser, 1999) were used to examine the text for types, purposes and other aspects of social activities that might be important for cognitive health. This involved an iterative process of reviewing the transcripts until core themes emerged. The transcripts were analyzed as the study progressed and we appeared to have reached saturation by 10 – 12 interviews. Collectively, the principal investigator and another investigator examined and decided upon a coding strategy. Analysis began with an open coding process that involved reading the transcripts and analyzing chunks of text. Initial themes included the types of social activity, elements of social activities, and aspects related to cognitive health. The next step involved comparing the identified themes to current theory and concepts from the literature. After final coding was completed, the memory performance score was revealed, and we looked for differences among those in the high and low memory groups. Throughout this process, investigators held consensus meetings to categorize the data, resolve code divergence, and decide upon the core codes.

4.4 RESULTS

4.4.1 Participants

Table 6 displays participants' sociodemographic characteristics by memory performance. The sample consisted of 20 older adults, 10 with a low memory score (4 to 6) and 10 with a high

memory score (7 or 8). Participants included 13 women and 7 men, aged 61 to 86 years (mean = 76 years). Those in the low memory group were slightly older (mean = 79 years) compared to those in the high memory group (mean = 73). The majority were Caucasian (n = 17), and 3 were African American. Most of the participants lived in their own homes, and with a spouse or significant other. One participant lived in a senior living community. Seventeen had completed high school or the equivalent, and more than half had attended at least one year of college. Looking at scores on the MIS-T, those in the low memory group had a lower average score (5.7) compared to those high memory group (7.8). Participants were also from 15 different neighborhoods throughout Allegheny County.

Table 6. Sample characteristics by memory performance

Variable	Low Memory (n = 10)	High Memory (n = 10)
Age, Mean (SD)	79 (5.5)	73 (8.1)
Female, n (%)	5 (50)	8 (80)
Caucasian, n (%)	8 (80)	9 (90)
Marital Status, n (%)		
Single	2 (20)	0 (0)
Married	5 (50)	8 (80)
Widowed	3 (30)	2 (20)
Education, n (%)		
Less than high school	2 (20)	1 (10)
High school grad or GED	2 (20)	4 (40)
Some college or college grad	6 (60)	5 (50)
MIS-T, mean (SD)	5.7 (0.7)	7.8 (0.4)

Notes: SD = standard deviation; GED = General Education Development; MIS-T = memory impairment screen for telephone.

For participants in our study, participation in social activities seemed to be one of the main ways they interacted with others. The social activities they participated in also seemed to define or encompass aspects of their personality or what was important to them. Data analysis identified three broad domains related to participation in social activities and their potential benefits for cognitive health: four types, purposes, and barriers.

4.4.2 Four Types of Social Activities

In response to our range of questions on social activities, participants said they engaged in a wide variety of social activities. However, our analysis revealed that activities mentioned by participants tended to fall into one of four types (Figure 1). These involved “Altruism,” “Creativity,” “Game,” and “Motion.” We also found that when participants were asked about the social activities that they liked to do most, they tended to list one or two as their favorite. We coded these favorite social activities as primary or secondary, based on how participants described the activity and the feelings they expressed about the activity.

Activity	Definition and Examples
Altruism	Social activities that involve doing for others or providing a service in order to help. Examples: volunteering, teaching, caregiving/babysitting, and planning or organizing for social group
Creativity	Social activities that involve imagination and the creation of different realities. Examples: watching theater, singing, painting, crocheting, learning about arts and craft, traveling and sightseeing, and bird watching.
Game	Social activities that involve playing games with varying levels of challenge, chance (winning or losing), and competition. Examples: problem solving, geocaching, gambling, bowling, and playing tennis, golf, bingo, or videogames.
Motion	Social activities that involve movement and/or altering one's perception. Examples: dancing, bike riding, exercising, swimming, hiking, kayaking, and taking aerobics and Tai Chi classes.

Figure 5. Description of social activity types

4.4.2.1 Altruism

Participants listed several different social activities that involved Altruism or helping others. The majority (18 out of 20) mentioned participating in some type of altruistic behavior on a regular basis. Social activities involving Altruism included volunteering with church or other organizations, participating in church-prayer groups and ministering, planning and organizing activities for others, and babysitting and/or other forms of caregiving. Participants used various words to describe these altruistic social activities, such as "giving," "supporting," "helping," "sharing," and "making others happy." We examined whether altruism was considered

participants' primary or secondary social activity, and 9 participants mentioned that engaging in Altruism was a very important part of their life. The following are examples of how Altruism was conveyed by participants:

> [T]here is something else I have to do in my life or I wouldn't be here. Hopefully, it is something that helps other people. There has always been a desire to help. I would have loved to be a teacher maybe. – (78 year-old woman, primary)

> There used to be this little hymn that children sang *Brighten the Corner Wherever You Are*. That is my purpose in life. I am brightening corners and trying to bring a little joy to people or a little more joy to people. – (80 year-old man, secondary)

4.4.2.2 Creativity

Creativity was represented by participants' interests in doing activities with others that involved using their imagination and/or being transported to a different reality. Creativity encompassed the following types of social activities: painting, singing, going to knitting or crocheting classes, traveling, being in nature, watching performances, and bird watching. Further, words used to describe these types of activities included "seeing new things," "creating," "exploring," "adventure," "learning," and "escaping to another world." Overall, only three participants did not mention doing some type of creative social activity. Based on our coding of primary and secondary social activities, 12 participants listed Creativity as an important part of their life. For example:

> Just give me time and money. I would travel. My mother told my first husband that when the stork delivered me, he forgot to unpack the bag. I love to travel. That would be my favorite thing. That is what I would like to do. – (76 year-old woman, primary)

> [Painting] just takes your brain out of the realm of reality, and you just get into your right brain and can totally relax. Once you are in it, you go "my God it is 12:30 and I have been doing it for three hours." I guess it is like a computer, but it is more pleasant and creative. – (69 year-old woman, primary)

4.4.2.3 Game

Participants often mentioned playing games with others as an important aspect of their social lives. Game-related activities were done with others for amusement, fun, and the chance of winning. It included solving puzzles, using skill and being challenged, aspects of chance or an opportunity to win or lose, and at times competition and at other times non-serious game-playing. Commonly mentioned Game-related social activities included playing cards, board games, and Wii games; sports such as bowling, tennis, and golf; games of chance like bingo, slots, and betting on football pools; and broader problem-solving activities, such as crossword puzzles, discussions on solutions to past or current problems, geocaching, and mathematical-related activities. Words used to describe these types of social activities included "never knowing the outcome," "challenge," "surprise," "logic," "problem solving," and "winning or losing." Game was mentioned by more than half of participants (16 out of 20), and we classified it as the primary or secondary social activity for 12 participants mentioned. Further, those who had Game as their primary or secondary activity often mentioned problem solving as a key element:

Well, we like to solve problems. Although it is not really problem solving. We use a Garmin [referring to geocaching] and we are not that lucky. It is just the excitement of finding it…you go out and see what you can find, enjoy it, and appreciate it. – (66 year-old woman, secondary)

> Well, I think you get a gem when somebody gives you an insight or perspective that you don't have. It is like finding a little diamond or nugget in the road. That is what you are looking for; the little nuggets. It is amazing what you don't know about things.… That is kind of what I like. – (77 year-old man, primary)

Participants also mentioned that competition was not the most important aspect of games, and that playing was never too serious. One participant, a 61 year old woman, said what she

liked about playing games was "just being around and socializing. Just playing and enjoying what you are doing. It is not whether you win or lose." A 75 year-old man said, "I like the competition to a point, but it isn't something that upsets me. If someone wins, I might laugh or kid around. If I win, I might kid or poke around." Finally, an 83 year-old African American man mentioned that "the driving forces of economic life are competition, cooperation, and human behavior. Now, you can put that into education or religious life or baseball life…. It is the everyday facets of life."

4.4.2.4 Motion

The last category of social activities mentioned by participants, Motion, represented those social activities involving movement and an altering of one's physical perception or state. Motion-related activities that were social or done in groups included swimming, biking, exercising, hiking, dancing, and taking aerobics and exercise classes (yoga, Tai Chi and Silver Sneakers). Several types of words were used to describe Motion-related social activities, including "moving," "movement," "keeping active," and "exercise." Overall, 15 out of the 20 participants mentioned doing some type of social activity involving Motion. Looking at whether it was a primary or secondary social activity, Motion was the least mentioned of the four activities, with only four people listing it as their primary or secondary social activity. Those who did mention Motion had the following to say:

> You get to move around and people be talking; talking while you have been moving. It is like a happy feeling. Like a party! When we get together, we are like show me how to do this. When we get together it is more like a party. I like it, I like it. … I like line dancing. – (74 year-old woman, secondary)

> I love doing Tai Chi…there is just this special feeling of just sharing something that we all enjoy and makes us feel good. Throughout my life, my most favorite thing was movement. There was something about me that I could express through movement that I

didn't express any other way. That is really pretty huge for me. – (61 year-old woman, primary)

4.4.2.5 Primary and Secondary

We also noticed that there was sometimes a connection between the social activities we coded as primary and secondary. Altruism was often connected to another type of social activity. For instance, two participants whose primary activity was Motion (line dancing and Tai Chi) were coded as having Altruism as their secondary activity because they often mentioned volunteering to teach others how to do the Motion-related social activity. Another participant who mentioned painting (Creativity) also volunteers (Altruism) to organize trips for her painting class. At other times, a primary social activity might be comprised of two elements. For example, bird watching involved traveling, being out in nature, and admiring the beauty of the birds (all could be considered Creativity), as well as not knowing what you'll see and having to search for birds (aspects of Game).

4.4.3 Purposes

Participants listed a range of reasons for participating in social activities. In response to asking participants, "What keeps you doing the social activities that you do?", participants' accounts seemed to depict a context in which social activities fulfilled a Purpose. Participants further framed the Purposes of participating in social activities in terms of their needs for *enjoyment*, *relaxation*, *stimulation*, and *belongingness*. Participants often mentioned more than one Purpose for their participation.

4.4.3.1 Enjoyment

Enjoyment was listed a major reason for why participants engaged in the different types of social activities. Terms such as “happiness,” “rewarding,” “gratifying,” “pleasure,” “fun,” and “makes you feel good” were used by participants to convey enjoyment as a Purpose for doing social activities. For instance, a 72 year-old woman mentioned the following about why she does Altruism-related activities: “I just like to help and make people happy. It makes me happy. If they are happy and content, then I am too.” Another participant, an 80 year-old man, mentioned that he did creative activities, such as going to operas and listening to classical music, because:

> Intuitively, I just love it… You know my heart leaps up when I behold a rainbow in the sky by Emily Dickinson. That’s it! My heart leaps up. Things make my heart leap up and make me feel good, really good. I have never been pinned down to why do I or what do I get out of this; pure pleasure, pure enjoyment. That is what it is all about.

Further, some participants mentioned that they wouldn’t participate in social activities if they didn’t enjoy them. Statements like “I wouldn’t do them if I didn’t enjoy them” and “I won’t do something if I don’t like it” reflected some participants’ desire for autotelic experiences and opportunities that allow them to do what they enjoy.

4.4.3.2 Relaxation

Other participants described a sense of relaxation when they participated in the different social activities. Relaxation was characterized by participants as an opportunity for escape, being restorative and nurturing to one’s body, and/or serving as a diversion. This often came up when asking participants about why they participated in Creativity-related activities. An 83 year-old man mentioned the following about spending a day doing anything he wanted:

> What I would do is get in my car and ... go to my friend Carl's house. Carl and I used to sing together.... We would sit down and we would end up singing. Anything I would want to do. I would go see Carl, and we would sing together. We'd sing gospel songs together.... That would be my relaxation for the day.

For some participants, social activities provided them with an opportunity to heal or nurture their bodies. They used terms like being fulfilled, refreshed, and/or restored to describe the Purpose of social activities. One participant talking about the Purpose of Tai Chi said,

> You are nurturing yourself. A lot of the movement involves a constant eV and flow, and it is nurturing like rocking a baby. I don't know if it is boiled down to endorphins or what, but you are influencing your nervous system distinctly…. I am centering myself, calming myself, learning how to move more efficiently, learning how breathe more efficiently and stand up with greater ease, learning to do everything better; and then you realize you are calm, quiet, more centered, and more relaxed.

4.4.3.3 Stimulation

Other participants expressed that they did social activities for stimulation or to keep their minds active. Stimulation was represented by participants' needs for challenge, discovery, learning, and fulfilling their interests. For instance, an 86 year-old man described his reason for attending educational courses as, "To keep my mind open and active is good. I am learning about things I never knew about before. I am more knowledgeable." Another 69 year-old woman, who talked about square dancing said,

> We started square dancing three years ago. Boy is that an activity to keep you alert mentally. It is a logical dance, and six other people are depending on you to remember what number you are in the group and where you are turning.

4.4.3.4 Belongingness

For some participants, the social aspect of these activities was an important Purpose. Several participants mentioned that they did social activities because of a desire for closeness, belonging, trust, and/or to feel respected and liked. They talked about the need for being with others, and the importance of maintaining social relationships. A 74 year-old African American woman expressing why she liked to do activities with others said,

> [It is] the communication and the togetherness. Just the atmosphere I like.… I listen to the atmosphere and the people, and I feel a part of it. I like to be around people. Just to be with people. I get involved.

Another 82 year-old woman described how the closeness she has with her sewing group reinforced her commitment to attend:

> A group of us get together every Thursday and sew blankets for Linus, babies. Lap robes for nursing homes and stuff…. We have a good time together, and we care for each other, and we call if we can't come. Well, I feel like I am compelled. Like where were you if I don't come. Only in cases of sickness will they accept an excuse for not coming. We are that close. They would be upset with me if I didn't come.

4.4.4 Differences by Memory

Next we examined whether there were differences in participants' engagement in the social activity types by memory performance (Table 7). This was done after final core codes were decided upon. Overall, participation in Creativity- and Game-related social activities did not seem to differ by memory performance. When looking at Motion, only about five participants in the low memory group ever mentioned participating in Motion-related social activities compared to all 10 participants in the high memory group. Further, only 8 participants in the low memory group reported doing Altruism, while all 10 in the high memory group reported doing some type of Altruism-related social activity. Examining our categorization of social activities as primary

and secondary, about the same number of participants had Altruism and Game as their primary or secondary social activity. Similar to overall findings, three participants in the high memory group were categorized as having Motion-related activities as their primary or secondary, while only one was categorized in low memory group. We also found that more participants (n = 8) in low memory group were classified as having Creativity-related activities as their primary or secondary compared to those in the high memory group (n = 6).

Table 7. Social activities categorized as primary/secondary by memory performance

	Low Memory		High Memory	
	Overall	Primary & Secondary	Overall	Primary & Secondary
Activity Category	N	N	N	N
Altruism	8	5	10	6
Creativity	9	8	9	6
Game	9	6	8	5
Motion	5	1	10	3

4.4.5 Barriers

We then examined participants' narratives to identify differences by memory performance. We identified two major themes that reflected barriers to participating in social activities—*withdrawal* and *impairment*. It seemed that participants in the low memory group frequently mentioned that they faced Barriers when trying to participate in activities with others. Sometimes

participants in the high memory group mentioned Barriers; however, Barriers did not seem to hinder participation in social activities.

4.4.5.1 Withdrawal

Withdrawal involved participants giving up social activities or mentioning that they no longer liked doing a social activity. For instance, one 78 year-old man from the low memory group mentioned:

> I taught computers at the senior center…. I taught it for about 5 or 6 years. They closed the senior center … and moved to the other center... it wasn't conducive to teaching the way I taught….I tell you what they bore me. Senior citizens bore the hell out of me. All they want to do is play bingo. I can't stand bingo, and there is no one there that I can converse with, talk to.

Other participants in the low memory group talked in similar ways about why they no longer do certain social activities, such as saying "I just got tired of doing it," "things have slowed down," and "just don't like to go anymore." In contrast, those in the high memory group tended to mention how they looked for new opportunities. A 66 year-old female participant from the high memory group said, "I am always looking for some excitement or try something different….When an opportunity comes around for a new experience, I usually jump on it." Another 72 year-old woman in the high memory group mentioned "I think in life as you get older, you have to keep active. Whatever you like to do, do it. It is really about that I think."

4.4.5.2 Impairment

Most of the participants in both memory groups had some type of Impairment, such as health, transportation, and social isolation. Those in the low memory group seemed to have more health

problems and complaints of social isolation (a shrinking social network). Health problems were a common Impairment for those in the low memory group. "My doctor said that I should stop tutoring and take it easy" said an 83 year-old man in low memory group. With regard to limiting activity, a 76 year-old woman, stated, "I have developed neuropathy in my feet, and I like to walk and do things like that. It has really limited it…. I am not walking anymore." Social isolation differed from withdrawal in that it had more to with changes to participants' social networks that were outside of their control. For participants in the low memory group, they were more likely to mention that social isolation impacted their ability to do activities with others. For instance, "I haven't found anyone that wants to go. A couple times I've chosen one of the musicals at the high schools, but I can never find anybody that wants to go." said an 81 year-old woman in the low memory group. Another 83 year-old woman in the low memory group stated, "They (friends) are all older than me and they have trouble walking….A lot of my friends are all dying off." Although those in the high memory group did at times mention health issues or social isolation, these Impairments did not seem to prevent them from doing social activities. For instance, a 78 year-old woman in the high memory group mentioned how even though she had a stroke three years ago, she still searches for activities to do with others, and strives to be more independent.

4.5 DISCUSSION

This study provides an in-depth look at the types and purposes of social activities in which adults participate in later life. The voices of these older adults and our overall interpretations provide a unique perspective on the importance of engaging in social activities in late life. We identified

four types of social activities, each with unique characteristics, which may operate in different ways to affect cognitive health. Participants also reflected on the various purposes that were fulfilled by these social activities. Furthermore, their accounts revealed that enjoyment, relaxation, stimulation, and belongingness were important reasons for why they participated in activities with others. Finally, our analysis suggested that there were some noticeable differences by memory performance, with those in the low memory group being more likely to mention withdrawing from social activities and encountering barriers to participation.

4.5.1 Social Activity Types and Implications for Cognitive Health

The four different types of social activities identified in our study are in line with previous work on the potential benefits of social activities on cognitive health in late life. There is some support for the beneficial effects of Altruism or volunteering on memory and overall cognitive health. Studies have suggested that volunteering may be beneficial to psychological and overall health in late life (Morrow-Howell, 2010; Tang, Choi, & Morrow-Howell, 2010). In the Experience Corps Study, participants assigned to intervention group (a volunteer program at elementary schools) experienced improvements in memory and executive function over four to eight months (Carlson et al., 2008). Opportunities for creativity may also be important in late life. Another qualitative study found that creativity may encourage successful aging by providing opportunities for problem-solving, motivation, and improved functional health (Fisher & Specht, 1999). Further, several studies examining the effects of art-related interventions have demonstrated that creativity may impact factors related memory and overall cognitive function. One study found that older adults who participated in chorale groups had less loneliness and higher morale compared to controls (G. Cohen, 2006; G. D. Cohen et al., 2007). Cohen (2006) also suggested

that the chorale group showed a trend toward better memory performance. Evidence from observational studies and randomized controlled trials have also demonstrated that participating in cognitively stimulating activities, such as games, may be beneficial to cognitive health (Hughes, 2010). Moreover, several studies have identified a connection between playing games and cognitive health (Hall et al., 2009; Leung et al., 2011). Finally, numerous studies have also identified physical activity as an important factor for maintaining cognitive health in late life (Lautenschlager, Cox, & Kurz, 2010; Lee et al., 2010). A recent randomized control trial found that participation in group Tai Chi classes, three times a week over 40 weeks, was associated with better overall cognitive functioning, including memory, and increased brain volume in community-based sample of Chinese older adults (Mortimer et al., 2012). Therefore, it seems plausible that social activities involving a physical activity component could be beneficial to cognitive health.

4.5.2 The Purposes of Social Activities and Cognitive Health

Our findings on several purposes of participating in social activities in late life, namely enjoyment, relaxation, stimulation, and belongingness, have been alluded to in previous studies on the physical, mental, and social well-being of older adults. Less research explored the specific relationships between enjoyment and cognitive health in late life. Rook (1987) notes that enjoyment is a major reason for why older adults participate in activities with others. Rook defines companionship—social activities done for non-productive reasons—as sharing leisure or other activities such as recreation, humor and fun with others for "the intrinsic goal of enjoyment." Evidence from several studies suggests there is a link between enjoyment and health in late life (Flatt & Hughes, in press). Companionship has been associated with lower

levels of loneliness, better relationship satisfaction, less emotional distress (Rook, 1987, 1994; Rook & Ituarete, 1999), and reporting better overall health (Ashida & Heaney, 2008). Less is known about how enjoyment specifically is important cognitive health, but research on the "pleasure-reward" system in the brain—a system that involves endorphins, dopamine, and serotonin—has suggested that enjoyment could have important implications for brain health (Winwood et al., 2007). The need for relaxation in late life further emphasizes another purpose fulfilled by social activities. Participating in social activities, especially those involving positive interactions, may be protective against chronic stress (Seeman et al., 2002). Berkman and Glass (2000) have speculated that participating in social activities in late life may buffer against stress by encouraging meaningful social roles that reinforce older adults' sense of identity and self-esteem (Fiori et al., 2007; Glass et al., 2006). There may also be a direct relationship between stress and cognitive health in late life (Lupien et al., 2009).

Drawing upon participants' experiences, it was clear that another purpose of participating in social activities for older adults was the need for stimulation. Older adults seem to be interested in social opportunities that provide cognitive stimulation. Another qualitative study found that older adults considered cognitive stimulation as an important aspect of successful aging (Reichstadt, Depp, Palinkas, Folsom, & Jeste, 2007). This further highlights older adults' interest in preventive strategies for maintaining cognitive health in late life. Participants also expressed that social activities provided a sense of belongingness. Baumeister and Leary (1995) have suggested that the need to belong or form social attachments is important for health and overall well-being. It may be important to overall psychological health, and it also could provide additional opportunities for social support (Kawachi & Berkman, 2001). Some studies have

suggested that social support could be protective of cognitive health (Dickinson, Potter, Hybels, McQuoid, & Steffens, 2011; Seeman et al., 2001).

4.5.3 Barriers and Cognitive Health

A number of studies have suggested that social withdrawal could be a possible prodrome of cognitive health problems (Glymour, Weuve, Fay, Glass, & Berkman, 2008; Kawachi & Berkman, 2001). For our study, older adults in the low memory group were more likely to mention a disinterest in doing certain activities with others. This phenomenon deserves further study. Older adults with cognitive health problems may benefit from strategies aimed at increasing motivation for continued engagement in social activities. Those in the low memory group were also more likely to mention having impairments that impacted their participation in social activities. Increasing older adults' participation in social activities in late life may necessitate efforts aimed at rebuilding social networks, preventing social isolation, and identifying social activities that can be participated in regardless of physical impairments.

4.5.4 Strengths and Limitations

Several strengths and limitations of our study should be noted. Our study was primarily inductive and based on accounts from a small purposive sample of older adults from Allegheny County. However, while this is a limitation, it could also be a strength since we were able to collect rich and highly detailed subjective experiences from older adults that provided a clearer and deeper understanding of the types and purposes of social activities in late life. While our conclusions about social activity types, purposes for participation, and potential benefits for cognitive health

may not apply strictly to other populations and regions, we have raised several questions that deserve further study. We also compared differences by memory performance, and our low and high memory groups may not have identified those with memory differences. Further investigation is necessary to examine these differences. Finally, while we discussed implications to overall cognitive health, memory is only one domain of cognition, and it seems important to examine how our findings could be applied to broader domains of cognitive functioning.

4.6 CONCLUSION

We identified four specific types of social activities that could have important implications for cognitive health in late life. These social activities may also fulfill a range of older adults' physical, mental, and social well-being—the opportunity for enjoyment, relaxation, stimulation, and a sense of belonging. Promoting and supporting these dimensions of well-being could have important implications for their cognitive health in late life. It is also important to consider older adults' barriers to participation in social activities, as well as the need for targeted efforts for those who are becoming socially isolated or withdrawing from activities. Future research should consider the different types of social activities, and their impact on cognitive health and well-being.

5.0 DIFFERENT TYPES OF SOCIAL ACTIVITIES AND THEIR RELATIONSHIP WITH MEMORY PERFORMANCE IN LATE LIFE

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Manuscript in preparation.

5.1 ABSTRACT

Purpose: To identify the associations between participation in four different types of social activities and memory performance in late life.

Methods: A cross-sectional descriptive study was conducted with a community-based sample of older adults—1,735 participants age 50 and older—participating in a study on the primary prevention of falls. Weekly participation in four types of social activities (Altruism, Creativity, Game, and Motion) were derived from the Community Healthy Activities Model Program for Seniors (CHAMPS) questionnaire. The Memory Impairment Screen for telephone (MIS-T) was used to assess memory performance.

Results: Participation in the four types of social activities varied by age, race, gender, educational attainment, marital status, mobility impairment and self-rated health. Participating in altruistic activities (OR 1.46; 95% CI 1.14, 1.88) was associated with better memory performance. Older adults who participated in two or more types of social activity in a typical week were 1.5 times more likely to have better memory performance (95% CI 1.17, 1.92).

Implications: The types of social activities that older adults participate in are most likely influenced by their sociodemographic as well as physical and cognitive health characteristics. Participation in different types of social activities in late life, especially altruistic activities, may have important implications for memory and overall well-being. Future research should consider whether different types of social activities are important for protecting and maintaining memory and overall cognitive health.

5.2 INTRODUCTION

Cognitive health is an important aspect of older adults' well-being, independence, and quality of life. Cognitive health involves the mental processes that are collectively known as cognition—memory and other abilities such as language, attention, judgment, and executive function—as well as the ability to lead a purposeful life (CDC, 2011). With population aging, more and more older adults are at risk for developing cognitive health problems in late life. Much work has been done to identify risk and protective factors for cognitive health problems, and one promising area of research suggests that participating in social activities may be beneficial for cognitive health.

Several longitudinal and population-based studies have found a connection between participating in social activities during later life and better cognitive health (Barnes et al., 2004; Bassuk et al., 1999; Bennett et al., 2005; Fratiglioni et al., 2004; James, Boyle, et al., 2011; Seeman et al., 2011; Singh-Manoux et al., 2003; Thomas, 2011b; Wang et al., 2002). Recent studies have shown that greater participation in social activities was positively associated with a range of cognitive health outcomes, including less cognitive decline (James, Wilson, et al., 2011; Wang et al., 2013), and decreased risks of cognitive impairment (Geda et al., 2011; Hughes et al., 2012) and dementia (Paillard-Borg et al., 2012). Some studies have suggested that participation in social activities (especially productive and leisure activities) may be important for cognitive health in late life (Bassuk et al., 1999; Carstensen & Hartel, 2006). However, less is known about the types of social activities that may be important for cognitive health.

There are most likely a range of different social activities that older adults engage in, ranging from cultural and community activities to those done with close or lifelong contacts. Older adults' participation in different social activities undoubtedly varies based on personal preferences and individual characteristics. But it has been suggested that several

sociodemographic factors, such as socioeconomic status, education, gender, and marital status, would generate important differences in social activity participation in later life (Carstensen & Hartel, 2006). These factors could also be important for encouraging and sustaining social activity participation. In that case, understanding these factors could help develop tailored social activity programs for older adults that adequately meet their needs.

Our study builds on findings from a qualitative study that utilized in-depth interviews with 20 older adults to determine the types and purpose of social activities in late life. That study identified four specific types of social activities that older adults tended to engage in on a regular basis. “Altruism” was defined as social activities that were done with others in order to make a contribution to society and/or help others. “Creativity” involved social activities that created new worlds or realities, and tapped into one’s imagination. “Game” represented social activities aimed at playing games with others (competitive and non-competitive), and involved skill and problem solving. “Motion” encompassed social activities that involved movement and altering one’s physical perception or state. Motion-related activities were more physical in nature, but were done with others.

To examine how participation in these different types of social activities was associated with cognitive health, we used cross-sectional data from 1,735 older adults from a study on the primary prevention of falls, Falls-Free PA. Our primary aim was to investigate the relationship between the four types of social activities and a measure of memory performance (the Memory Impairment Screen by telephone or MIS-T). This measure of memory performance examines episodic memory or the ability to learn and recall new information (Petersen et al., 1997; Plancher et al., 2012). While this measure does not capture all mental processes (our definition of cognitive health), problems with episodic memory are a common concern for older adults; they

may also indicate an early manifestation of Alzheimer's disease (Jagust, 2009; Lipton et al., 2003). We also examined whether personal characteristics were related to participation in the different types of social activities.

5.3 METHODS

5.3.1 Participants

Participants were enrolled in Falls-Free PA, a statewide study in Pennsylvania that examined the primary prevention of falls. Participants were age 50 and older, and were recruited from senior centers across Pennsylvania between November 2010 and December 2011. All participants signed an informed consent, and the study was approved by the Institutional Review Board of the University of Pittsburgh. Further details of this fall prevention study are described elsewhere (Albert et al., forthcoming). Inclusion criteria for Falls-Free PA were 1) being a community-dwelling resident of Pennsylvania, 2) age 50 or older, 3) not being decisionally impaired (having severe cognitive impairment or dementia), 4) not having a life threatening illness, 5) not planning to move in the next 12 months, and 6) attending a senior center that offered either of the two fall prevention programs.

5.3.2 Measures

Eligible participants completed the baseline interview over the telephone, and data were collected on sociodemographics, health status, participation in weekly activities via the

Community Healthy Activities Model Program for Seniors (CHAMPS) questionnaire (Stewart et al., 2001), and memory, which was assessed via the MIS-T (Lipton et al., 2003). Participants who did not complete the CHAMPS or MIS-T were excluded from analysis.

5.3.2.1 Sociodemographic and Health Factors

Sociodemographic factors included age (50 to 69, 70 to 79, and 80 and older), gender, education (less than high school, high school or equivalent [GED], some college, and college graduate), marital status (single, married, divorced/separated, and widowed), and race (Caucasian, African American). Additional health-related factors were examined because of their potential association with memory performance and social activities, including mobility impairment (no problems vs. some or a lot), and comorbidities (1 vs. 2 or more of the following: heart disease, depression and anxiety, arthritis as well as several other chronic conditions). Self-rated health was assessed with a single-item question, with response categories ranging from 0 (worst imaginable health state) to 100 (best imaginable health state). We created a dichotomous variable (low [0-79] vs. high [80-100]).

5.3.2.2 Social Activity Types

To examine participation in social activities, we used the 41-item CHAMPS questionnaire, which assesses participation in physical, recreational, and social activities done in a typical week over the past month. It also has one open-ended question that asks about other activities not previously mentioned. The questionnaire was originally designed to assess the effectiveness of a physical activity intervention. When designing the questionnaire, Stewart and colleagues (2001) considered memory difficulties and incorporated lists of different activities to make recall easier. To minimize socially desirable responses, other activities such as social activities, volunteering

and hobbies were included. The CHAMPS questionnaire has been used in past studies with persons with memory problems (Lautenschlager et al., 2008).

Responses to social activity-related items and the one open-ended question on the CHAMPS questionnaire were categorized into four types of social activities (Altruism, Creativity, Motion, and Game) based on findings from a previous qualitative study (Figure 6). Each social activity type was coded as doing any (yes) or not doing any (no) in a typical week. Altruism represented doing any social activities involving volunteer work, attending clubs or group meetings, teaching, babysitting or caregiving.

Social Activity Types
Altruism – social activities that involve doing for others or providing a service in order to help. Activities: doing volunteer work, attending club or group meetings, babysitting, caregiving, and teaching.
Creativity – social activities that involve the creation of different realities and allow for escape. Activities: going to concerts, movies, lectures, or sport events, participating in arts and craft activities, playing musical instrument, and singing.
Game – social activities that involve playing games; competitive and non-competitive. Activities: Playing cards, bingo, board games, golf, tennis, bowling, and Wii games.
Motion – social activities that involve movement that alters one's physical state. Activities: dancing, riding a bicycle, taking aerobic classes, and taking yoga or Tai-Chi.

Figure 6. Description of the different social activity types

Creativity was represented as doing any art-related social activities, such as going to concerts, movies, lectures or sport events; doing arts and crafts such as needlework, drawing or painting; and playing a musical instrument and singing. Game involved doing any competitive and non-competitive social activities, such as playing cards, bingo, board games, golf, tennis, bowling, and Nintendo Wii games. Motion represented social activities that were more physical

in nature, such as dancing (ballroom, line, and square), riding a bicycle, taking aerobics classes, and doing yoga or Tai-chi.

5.3.2.3 Memory Performance

To assess our outcome of memory performance, we used the MIS-T, which is a brief four-item assessment that has been validated for measuring episodic memory performance in community-based samples (Buschke et al., 1999; Lipton et al., 2003). The assessment involves participants repeating four words, identifying a semantic category (cue) for each word, and then recalling the words after a short delay (3 to 4 minutes). Freely recalled words received two points, and cue-recalled words received one point. Scores may range from 0 to 8, with higher scores suggesting better memory performance (Kuslansky et al., 2002). A score less than 4 or 5 has been suggested for possible memory impairment or dementia. We decided to use a cut-point of 5 or less because it allowed for larger groups for comparison, and because this cut-point is more likely to capture participants that did not recall all four words. Further, it has been suggested that using this cut-point could provide greater sensitivity than a cut-point of 4, while sacrificing very little in terms of specificity (Buschke et al., 1999).

5.3.3 Data Analysis

All data analyses were conducted in SPSS (Statistical Package for Social Sciences) version 20.0. Chi-square tests were used to identify sociodemographic and health-related factors associated with participation in each of the types of social activities. We also used chi-square tests to identify whether participant characteristics were associated with memory performance. To examine the association between each type of activity and doing more than two types of

activities with memory performance, we conducted separate multivariate logistic regression analysis with each activity types as an independent variable and memory performance (scoring 0 to 5 vs. 6 or more) as the dependent variable. All of the social activity-type predictors were dichotomized as doing any (yes) or not doing any (no) social activities in that category during a typical week. All models were adjusted for age, race, gender, education, mobility impairment, and self-rated health. Adjusted Odds Ratio (OR) and 95% confidence interval (95% CI) were obtained for each activity type and doing two or more types, and a p-value < 0.05 was considered statistically significant. No adjustments were made for multiple comparisons because of the exploratory nature of this study.

5.4 RESULTS

Of the 1,735 participants who completed the CHAMPS Questionnaire and MIS-T, close to 80% were female and the majority were age 70 or older (Table 8). Of these participants, 89% were white, and about 9% African American. About 35% of participants were married, 45% were widowed, and 20% were single, separated or divorced. The majority had a high school education or higher, with close to 40% attending some college. Examining the cut-point for MIS-T, a little more than 20% (n = 359) were considered to have low memory performance (a score ranging from 0 to 5).

Examining the types of social activities (Table 9) reported on the CHAMPS questionnaire, the most commonly reported social activities done in a typical week were playing bingo, cards and board games (51.2%), participating in volunteer work (41.1%), doing arts and crafts (28.4%), going to concerts, movies, etc. (19.6%), taking part in club or organization

meetings (18.4%), riding a bicycle (13.6%), and participating in aerobics and aerobics dancing (11.6%). Based on the four social activity types, about 56% reported engaging in Game, 49% in Altruism, 45% in Creativity, and 35% in Motion. Sixty-one percent of participants reported doing two or more types of social activities in a typical week.

Table 8. Sociodemographic and health characteristics (N = 1735)

Characteristic	Value % (N)
Age	
50 to 69	27.8 (481)
70 to 79	40.2 (696)
80 and older	32.0 (556)
Gender	
Male	20.2 (350)
Female	79.8 (1385)
Race/Ethnicity	
White	91.3 (1584)
African American	8.7 (151)
Education	
Less than HS	13.2 (228)
HS or GED	48.0 (832)
Some college	23.7 (411)
College grad	15.1 (261)
Marital status	
Single	9.6 (166)
Married	34.6 (599)
Separated/divorced	10.8 (187)
Widowed	45.0 (779)
Impaired mobility	37.6 (653)
Comorbidities	79.2 (1267)
Self-rated health	
Low (0-79)	37.3 (647)
High (80+)	62.7 (1087)
Memory Performance	
Low (0-5)	20.9 (359)
High (6+)	79.1 (1355)

Notes: HS = High School; GED = general educational development.

Table 9. Overall participation in social activity types

Social activities types	Value % (N)
Altruism	
Club or organization	18.4 (316)
Volunteer work	41.1 (707)
Any altruistic activity	49.0 (850)
Creativity	
Art and crafts	28.4 (489)
Concerts, movies, lectures and sport events	19.6 (337)
Play instrument	6.3 (109)
Any creative activity	44.8 (777)
Game	
Bingo, cards, and board games	51.2 (880)
Bowling	2.2 (38)
Golf	2.0 (34)
Pool/billiards	2.0 (35)
Wii Games	2.7 (47)
Any game-related activity	55.7 (967)
Motion	
Aerobics classes	11.6 (199)
Dancing (line, ballroom, square)	8.3 (142)
Ride Bicycle	13.6 (233)
Yoga/Tai-chi	8.7 (150)
Any motion-based activity	35.2 (610)
Two or more	61.0 (1059)

Notes: Totals for any activity type do not add up since participants could report doing more than one. Activities based on participation in a typical week.

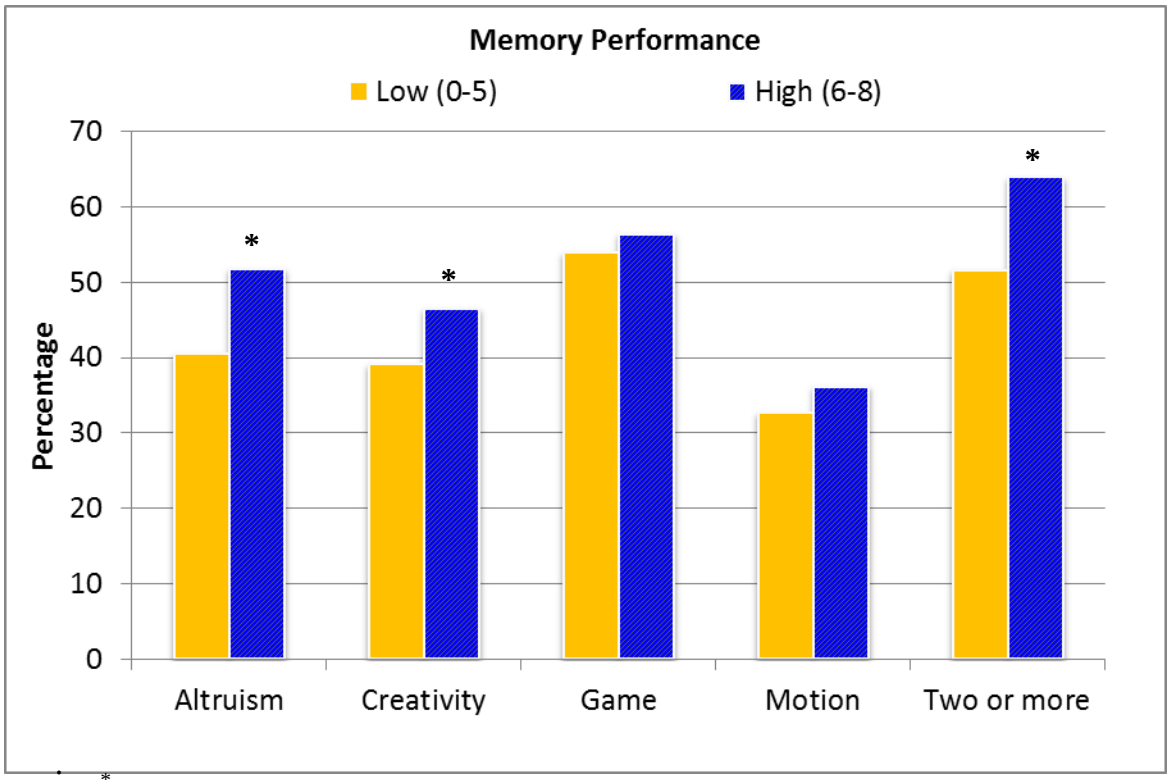
Chi-square tests revealed that age, gender, education, race, mobility impairment, and self-rated health were related to memory performance. Having comorbid conditions was not related to memory performance (results are not shown). Table 10 depicts participation in the social activity types by sociodemographic and health factors. Participation differed by age, gender, educational attainment, and self-rated health.

Table 10. Sociodemographic and health factors by participation in social activity types

Variable	Altruism (n = 850) % (n)	Creativity (n = 777) % (n)	Game (n = 967) % (n)	Motion (n = 610) % (n)	Two or more (n = 1059) % (n)
Age					
50 to 69	51.1 (246)	49.5 (238)	50.3 (242)	39.9 (192)	62.4 (300)
70 to 79	49.1 (342)	47.0 (327)	54.9 (382)	38.6 (269)	61.8 (430)
80 and older	47.1 (262)	37.9 (211)	61.5 (342)	26.8 (149)	59.0 (328)
Gender					
Male	46.3 (162)	32.6 (114)	52.0 (182)	30.0 (105)	51.1 (179)
Female	49.7 (688)	47.9 (663)	56.7 (785)	36.5 (505)	63.5 (880)
Race/Ethnicity					
White	49.6 (786)	45.4 (719)	56.4 (894)	35.2 (557)	61.9 (980)
African American	42.4 (64)	38.4 (58)	48.3 (73)	35.1 (53)	52.3 (79)
Education					
Less than HS	35.5 (81)	35.1 (80)	66.7 (152)	21.1 (48)	50.9 (116)
HS or GED	45.9 (382)	42.7 (355)	61.7 (513)	33.1 (275)	61.1 (508)
Some college	53.0 (218)	47.9 (197)	50.6 (208)	41.8 (172)	64.7 (266)
College grad	63.6 (166)	54.8 (143)	35.6 (93)	42.9 (112)	63.6 (166)
Marital Status					
Single	51.2 (85)	38.6 (64)	50.0 (83)	31.9 (53)	57.2 (95)
Married	51.1 (306)	46.6 (279)	50.1 (300)	40.4 (242)	61.4 (368)
Separated/divorced	49.2 (92)	45.5 (85)	56.7 (106)	41.7 (78)	64.2 (120)
Widowed	46.9 (365)	44.8 (349)	61.2 (477)	30.4 (237)	61.1 (476)
Mobility Impairment					
No	51.3 (555)	46.4 (502)	54.2 (586)	41.1 (445)	64.5 (698)
Yes	45.2 (295)	42.1 (275)	58.3 (381)	25.3 (165)	55.3 (361)
Comorbidities					
No	50.9 (169)	44.9 (149)	54.5 (181)	38.9 (129)	60.5 (201)
Yes	49.1 (622)	45.1 (571)	55.6 (704)	34.7 (440)	61.4 (778)
Self-rated health					
Low	41.0 (265)	38.5 (249)	59.0 (382)	27.0 (175)	54.9 (355)
High	53.8 (585)	48.5 (527)	53.7 (584)	40.0 (435)	64.7 (703)

Note: HS = high school; GED = general educational development.

Figure 7 depicts the bivariate association between participation in each social activity type and memory performance. Based on chi-square analyses, participation in Altruism, Creativity, and two or more categories were associated with better memory performance (all p-values < 0.05). Next, we tested whether there was a relationship between each social activity category with memory performance adjusting for sociodemographic and health-related variables in multivariate logistic regression models (Table 11). Reporting participation in altruistic activities in a typical week was associated with better memory performance (OR = 1.46, 95% CI: 1.14, 1.88), and participation in game-related activities was marginally associated (OR = 1.25, 95% CI: 0.97, 1.60, p = 0.08). Further, older adults participating in two or more social activity categories in a typical week were 1.5 times (95% CI: 1.17, 1.92) more likely to have better memory performance.



Note: *p-values < 0.05; unadjusted models

Figure 7. Bivariate association between social activity types and memory performance

Table 11. Odds ratios for association between each social activity type and memory

Activity types	Memory Performance Adjusted OR (CI 95%)
Altruism	1.46 (1.14, 1.88) **
Creativity	1.10 (0.85, 1.41)
Game	1.25 (0.97, 1.60)
Motion	0.95 (0.73, 1.24)
Two or more	1.50 (1.17, 1.92) **

Notes: Models were adjusted for age, gender, race, marital status, education, mobility impairment, and self-rated health; Activity types based on participation in a typical week; CI 95% = 95% confidence interval; Hosmer-Lemeshow test p-values > 0.05 for all models; ** $p < 0.01$

5.5 DISCUSSION

We examined the association between participation in four types of social activities and memory performance in a community-based sample of older adults. Participating in altruistic and two or more social activities was associated with better memory performance. Further, we found that more than half of our sample participated in different types of social activities. Women tended to be more socially active than men, and participation seemed to be dependent on age, educational attainment, and self-rated health. Examining each type of activity, women were more likely to report doing Creativity- and Motion-related activities. Participation in each of the types of activities was associated with educational attainment, and reporting participation in each of the types of social activities increased as educational attainment increased, except for Game-related social activities. Those with higher education levels were less likely to report doing Game-related activities. Lower self-rated health also seemed to impact participation in social

activity. Finally, age was also a factor, with those that were older being less likely to participate in the different social activity types.

By separating social activities into four types, we identified that Altruism-related, Creativity-related, and doing two or more of these types of social activities were associated with better memory performance. After adjusting for sociodemographic and health-related factors, only Altruism-related, Game-related (only slightly), and doing two or more activities were associated with better memory performance. We also found that sociodemographic (age, gender, education) and health factors (mobility and self-rated health) influenced the associations between social activity types and memory performance. Therefore, older adults' participation in different social activities may depend on several individual-level factors, and these factors should be considered when planning and developing social programs for older adults.

Very few if any studies have examined the effects of different types of social activities on cognitive health outcomes. Most studies tend to examine overall participation in social activities, which typically involves the use of a composite score. While some studies have identified a relationship between different types of leisure activities and cognitive health outcomes (Elwood et al., 1999; Singh-Manoux et al., 2003), no studies could be identified that looked at different types of social activities that could be important for memory performance or broader aspects of cognitive health. Some studies have shown that creative social activities have beneficial effects in older adults with dementia, especially in regards to mood and quality of life (Flood & Phillips, 2007; McFadden & Basting, 2010). It has also been suggested that the prefrontal cortex—an area of the brain linked to executive function and memory—is directly involved in the creative process (Dietrich, 2004). Similarly, several studies have recognized that volunteering may be beneficial to older adults' cognitive health and overall well-being (Morrow-Howell, 2010; Tang

et al., 2010). Findings from the Experience Corps study, a randomized trial examining the effects of a volunteer program for older adults, found that memory and executive function improved in those in the volunteer arm (Carlson et al., 2008). Further investigation using functional magnetic resonance imaging (fMRI) found support for improved brain function (Carlson et al., 2009)—specifically increased brain activity in the prefrontal cortex.

It has been proposed that social activities in late life may affect cognitive health through different mechanisms. According to the cognitive-enrichment hypothesis, cognitive, social, and physical activities have a positive effect on cognitive health in late life (Hertzog, Kramer, Wilson, & Lindenberger, 2008). Studies looking at the impact of enriched environments in animals models (Nithianantharajah & Hannan, 2009) have also found protective effects for cognitive health. However, reasons for the protective effects are unclear. Some have suggested that social activities may enhance or maintain neural integrity that is important for cognitive reserve and neural plasticity (Tucker & Stern, 2011); It has been suggest that this represents the potential efficiency and resiliency of the brain in old age. Engaging in social activities could also help to relieve stress, improve mood, and provide a sense of purpose (Glass et al., 2006). Further research on these neurocognitive and psychological processes are necessary to better understand which causal mechanisms responsible.

There were several key limitations that need to be addressed. First, the CHAMPS questionnaire was not designed to intentionally capture the four types of social activities that we examined. This limits the detail we have on different social activities, and we assigned the types a priori based on social activity types identified in a prior qualitative study. It is also possible that some activities were not done with others. A more detailed social activity questionnaire, as well as factor analysis, could help to validate the categories we identified. Second, our coding scheme

for the different types of activities was binary (did any or didn't do any), and we did not examine frequency of participation. However, responses were based on doing the social activity in a typical week. Third, our study is cross-sectional and cannot make causal claims. Further, the relationship between social activity types and memory performance could work in reverse or could be bi-directional; meaning that less participation in the different types of social activities could be a marker of memory problems.

Despite these limitations, this research offers a first glimpse into how different types of social activities could be important for memory. Future research is needed to examine a more fine-grained relationship between these social activity types and memory performance as well as other cognitive health domains. Longitudinal and further experimental work is necessary to determine the physiological and psychological mechanisms by which social activities could affect memory and overall cognitive health in late life. Nevertheless, our results offer preliminary evidence that engaging in certain types of social activities, especially those involving altruism, may be important for memory performance in older adults.

6.0 SUMMARY OF FINDINGS

The results of our three studies help to further elucidate the relationship between memory performance and older adults' social environment. Specifically, we utilized a mixed methods research design to examine how structural characteristics of social networks and types of social activities were related with older adults' memory performance. The first study (Study 1) showed that older adults' memory performance was associated with several structural characteristics of social networks: network size, number of friends, average degree centrality, largest clique size, and network constraint. We found support for our hypothesis that memory performance would be related to network size ($\beta = 0.15$, $p < 0.001$), and that networks would be smaller for those with worse memory performance. With regard to our hypothesis on cohesiveness, our results suggested that memory performance was positively associated with average degree centrality ($\beta = 0.13$, $p < 0.001$), which represents greater network interconnectivity, and was positively associated with largest clique size ($\beta = 0.12$, $p < 0.01$). We did not find support for our hypothesis that worse memory performance would be associated with having a greater number of family members than friends; however, those with worse memory performance did have fewer friends. Another interesting finding involved the association between memory performance and network constraint. Memory performance was negatively associated with network constraint ($\beta = -0.12$, $p < 0.01$), in which the ego's position in the network (spanning a structural hole) may influence his/her's access to social capital and other novel resources. We also found that change

in memory performance over six months was associated with several of our cross-sectional network structures. Our findings on the network structure speak to several potential mechanisms that may be important for memory and overall cognitive health, such as the role of emotional closeness based on the Socioemotional Selectivity Theory (Lang et al., 1998), the beneficial effects of social support and social capital, and other physiological mechanisms (e.g., social relationships could provide cognitive stimulation, relieve stress, and promote overall physical health).

In our second study, we identified several themes surrounding social activity participation in late life and their potential implications for cognitive health. Twenty face-to-face in-depth interviews were conducted with a purposive sample of older adults with low memory (n = 10) and high memory (n = 10) performance. Participants were from 15 neighborhoods in Allegheny County, and the interviews lasted a little more than an hour on average. We asked participants about the types of social activities they engaged in, their reasons for engaging in the social activities, and any potential barriers to participation. The qualitative method of grounded theory was used to analyze the narrative data. We identified four types—Altruism, Creativity, Game, and Motion—that represented the different social activities done in later life. Altruism (e.g., volunteering, teaching or caregiving) involved doing for others or providing a service in order to help. Creativity represented social activities that tapped into the imagination and/or created different realities (e.g., singing, painting, traveling and sightseeing). Game involved playing games with varying levels of challenge, chance (winning or losing), and competition. Game-related social activities included problem solving, geocaching, gambling, bowling, and playing tennis, golf, bingo, or videogames. Finally, Motion involved social activities with movement and/or an altering of one's perception, such as dancing, exercising, and taking aerobics and tai

chi classes. Participants' accounts suggested that the purposes of social activity participation included enjoyment, relaxation, stimulation, and belongingness. After identifying the core codes, we noticed that those who had worse memory performance were more likely to mention barriers to social activity participation—social withdrawal, health problems and social isolation. Several intervention studies have found that these four social activities may be important for cognitive health in late life. Further research is needed to examine how social withdrawal and social isolation are related to cognitive health outcomes in old age.

Our third study examined whether the four types of social activities identified in Study 2 were related to memory performance. We found that participating in Altruism (adjusted OR = 1.46; 95% CI: 1.14, 1.88) and two or more types of social activities (adjusted OR = 1.50; 95% CI: 1.17, 1.92) in a typical week were significantly associated with better memory performance (MIS-T score of 0 – 5 vs. 6 or higher). Game-related activities were marginally associated (adjusted OR = 1.25; 95% CI: 1.00, 1.68; p = 0.08). After adjusting for several sociodemographic and health-related factors, we did not find support for our hypothesis that doing creative activities would be associated with better memory performance. After examining participants' sociodemographic and health-related characteristics, we found that women tended to be more socially active than men, and that participation in the different types of social activities were associated with age, educational attainment, and self-rated health status. Education attainment and self-rated health seemed to effect participation in social activities in similar ways. Interestingly, those with lower educational attainment and worse self-rated health were more likely to report participating in Game-related social activities. A recent study found that altruistic-related social activities in late life were associated with increased brain activity in the prefrontal cortex—an area of the brain linked to executive function and memory. Future

research, including longitudinal and experimental studies, is needed to determine the mechanisms by which social activities could affect memory and broader cognitive functioning in late life.

Overall, these three studies have provided some support for the role that social networks and social activities may play in cognitive health in late life. However, we only examined one aspect of cognitive health, memory, and all of our findings are based on cross-sectional correlations, with no ability to make causal inferences. Study 1 found that memory performance was related to several structural characteristics of social networks, which held after adjusting for sociodemographic and health characteristics, and when examining change in memory performance over six months. Social network resources, such as emotional closeness and access to social capital, may be important for memory and overall cognitive health in late life. Findings from our qualitative study (Study 2) identified four types of social activities that were done in late life, as well as the purposes and the implications of participating in these social activities on cognitive health. However, social withdrawal and social isolation are two additional factors that deserve further attention. Study 3 found that volunteerism (Altruism) and participating in several social activities were associated with better memory performance. Intervention studies have shown that volunteer activities may improve cognitive health, especially memory and executive function, in those at risk for cognitive health problems. Further study of these social phenomena could help to better explain how social relationships may be important for cognitive health (especially memory performance) in later life. Further examination of the potential bidirectional relationship is also warranted as it could help researchers to identify leverage points for interventions. Finally, our findings speak to the need for better understanding the causal

mechanisms (physiological and psychological) that could help to explain the effects of older adults' social environment on cognitive health and well-being.

7.0 FUTURE RESEARCH

Future work should consider how best to assess older adults' social environment. Collecting self-report data from older participants has many limitations, especially when asking those with possible memory problems to recall past events or social interactions. With the advances in technology, we can now rely on wireless modalities (e.g., sensors or mobile devices) to capture real-time data on social networks and social activity participation (Choudhury, Philipose, Wayatt, & Lester, 2006). Perhaps another way to collect more valid data on social network and social activity participation is through the experience sampling method (Csikszentmihalyi & Larson, 1987); this would involve collecting real-time self-report data on networks or participation in social activities at random from older adults. This would also provide richer data that better characterizes the personal and subjective views of older adults. Beyond the social interaction data, information could also be collected on participants' moods, thoughts, and other perceptions. Another possible strength of the experience sampling method is being able to minimize the effects of memory problems inherent in self-report surveys (Fitzgerald-DeJean, Ruben, & Carson, 2012). However, because these methods could be invasive, one has to avoid having a detrimental impact or influencing the experience in other ways. The strengths and weaknesses of both methods should be considered, but it is clear that novel methods are necessary to better understand the connection between older adults' social environment and cognitive health.

The use of neuroimaging technologies, such as functional magnetic resonance imaging (fMRI) and positron emission tomography (PET), could provide greater understanding of how the social environment may affect brain health and function. One recent study found support for participation in social activity and increased brain and gray matter volume over five years (James et al., 2012); however, further study in more diverse samples is greatly needed. It also seems important to examine biomarkers, such as cortisol and other markers of allostatic load (Juster, McEwen, & Lupien, 2010; Seeman, Singer, Rowe, Horwitz, & McEwen, 1997), that may help to examine whether biological mechanisms can be used to better explain how the social environment affects cognitive health in late life.

Addressing these issues will be especially useful to future studies and behavioral interventions. Based on epidemiological findings, consideration should also be given to testing whether modifying social networks and/or social activity participation is a viable intervention for improving cognitive health in older adults. Several studies have shown that social activity-based interventions are appropriate and may affect cognitive function as well as other health outcomes in older adults at risk for cognitive problems (Pitkala, Routasalo, Kautiainen, Sintonen, & Tilvis, 2011; Pitkala, Routasalo, Kautiainen, & Tilvis, 2009); both older adults and their caregivers could benefit from these efforts. Results can also be used to inform current and future social programs, community efforts, and public policies aimed at older adults' cognitive health, along with the potential to enhance everyday functions important for independence and quality of life.

8.0 PUBLIC HEALTH IMPLICATIONS

As life expectancy continues to increase, there is a need for public health efforts to encourage successful aging over the lifespan. Research on determinants of successful aging tend to pay greater attention to the prevention of illnesses and disability (Depp, Harmell, & Vahia, 2012); however, Rowe and Kahn (2000) suggest that successful aging is multidimensional, and involves 1) preventing disease and disability, 2) maintaining physical and cognitive function, and 3) remaining engaged in social and productive activities. This dissertation highlights the need for greater focus on these last two dimensions.

Based on the demographic transition, there is evidence that our population is growing older and older. Promoting and preserving cognitive health has become a pertinent health concern for this aging population. Cognitive health represents the mental processes that are collectively known as cognition—memory, language, attention, executive function, judgment, and the ability to lead a purposeful life (CDC, 2011). Others have suggested that cognitive health encompasses a continuum of cognitive function (Lee et al., 2010), represented as preventing cognitive decline and impairment, and/or minimizing risks for dementia in later life.

Aging is a major risk factor for cognitive health problems. Loss of memory and other mental capacities are common fears for older adults (Anderson & McConnell, 2007). Estimates suggest that more than 88.5 million individuals in the U.S. will be age 65 and older by 2050. Based on this population estimate, the number of persons with AD will triple, with more than 13

million older adults in U.S. having AD (Hebert et al., 2013). This will place further strain on the U.S. economy (costs estimated to be as high as $1.1 trillion dollars), and the dwindling health care workforce will require families to take on the majority of the burden of providing care and support for these individuals (Alzheimer's Association, 2012).

Maintaining cognitive health in late life is an emerging public health issue with important implications for population aging and the well-being of older adults and families in an aging society. This public health need is further reinforced by the increasing prevalence of dementia that is expected with the aging of the Baby Boomers. As a result, increased efforts are necessary to prevent cognitive impairment and dementia, which could offset morbidity and mortality risks and burdens to individuals, families, and society. Several lifestyle factors have been found to be associated with cognitive health in late life; and there is some evidence that one of the dimensions of successful aging—having an active social life—could play an important role in older adults' cognitive functioning.

This dissertation focused on two components of successful aging, cognitive health (represented by our measure of episodic memory) and the social environment (structural characteristics of social networks and participation in social activities). Our results support previous findings that have suggested there is a link between an active and integrated social life and better cognitive health in late life. Further, our findings raise new questions about the mechanisms through which the social environment may impact cognitive health. First, greater cohesion—or perhaps greater emotional closeness—may be an important structural network characteristic that has implications for memory performance in late life. Second, access to social capital may be limited in those with memory problems. We also identified four types of social activities in which adults participate in later life. Participating in two or more social activities in

a typical week, especially volunteering (i.e., Altruism), was associated with better memory performance. However, it is less clear why these types of social activities may be important for memory and overall cognitive health. Perhaps it has to do with the purposes of social activities, such as enjoyment, stimulation, relaxation, and belongingness. These questions require further investigation.

In conclusion, we found that two aspects of older adults' social environment could be important for cognitive health, especially memory. Social networks and participating in social activities in late life are two areas that deserve further attention. Studying this body of work also helps to depict the social context in which older adults are embedded, and to identify social factors that are important for cognitive health and overall well-being. Further research from population-based and longitudinal studies can help to inform behavioral and health interventions. Developing interventions that promote cognitive health in late life and delay the onset of dementia will also have a broader public health impact. Findings from these studies can help local communities to plan and develop programs that encourage successful aging, and the culmination of these efforts can be used to inform public policies aimed at maximizing older adults' independence and quality of life while allowing them to age in place.

APPENDIX A

SOCIAL ACTIVITY NETWORK QUESTIONNAIRE

Participant ID: _____

Social Activities Network Questionnaire

Now we are going to ask you some questions about the people you spend time with. We will begin by asking you to identify people you did activities with over the past year. You may refer to these people in any way you want; for example, you may use just their first name or a nickname. We are not interested in the identities of these persons; we just need to have some way to refer to them so that when we ask you some follow-up questions we both know whom we are talking about.

Q1. We are interested in learning about the people you spend time with. Looking back over the past year, who are the people with whom you did activities most often? This could include activities like visiting together, going somewhere, sharing meals, playing games, etc.)

Enter up to **8 names** in the roster in the order in which they are identified by the respondent.

***Prompt:** If respondent lists less than 8, ask if there are any more?

Name 1_____ Name 5_____

Name 2_____ Name 6_____

Name 3_____ Name 7_____

Name 4_____ Name 8_____

Q2. Which of the following best describes (name)'s relationship to you?

(Options: 1 - Family, 2 - Friend, 3 - Acquaintance, 4 – Other, 99 - DK)

Name 1_____ Name 5_____

Name 2_____ Name 6_____

Name 3_____ Name 7_____

Name 4_____ Name 8_____

Q3. On a scale of 1 to 10, with 1 being not at all to 10 being very much, how much do you enjoy doing activities with (name)?

Name 1_____ Name 5_____

Name 2_____ Name 6_____

Name 3_____ Name 7_____

Name 4_____ Name 8_____

Q4. How often do you do activities with (name)?
(Options: 1 - Daily, 2 - Weekly, 3 - Monthly, 4 -Yearly, 99 - Don't know)

Name 1_____ Name 5_____

Name 2_____ Name 6_____

Name 3_____ Name 7_____

Name 4_____ Name 8_____

In the last set of questions, I'm going to give you two of the names you listed earlier, and ask you if they have done activities together in the past year.

Q5. Have (name _) and (name _) done activities together in the past year?
(Options: 1 - Yes, 2 - No, 99 - DK)

	Name 1	**Name 2**	**Name 3**	**Name 4**	**Name 5**	**Name 6**	**Name 7**	**Name 8**
Name 1		1.	2.	3.	4.	5.	6.	7.
Name 2			8.	9.	10.	11.	12.	13
Name 3				14.	15.	16.	17.	18.
Name 4					19.	20.	21.	22.
Name 5						23.	24.	25.
Name 6							26.	27.
Name 7								28.

APPENDIX B

THE MEMORY IMPAIRMENT SCREEN

MEMORY IMPARMENT SCREENING

Now I would like you to repeat a few words for me.: Bingo, Chair

1. YES *(able to repeat)* 0. NO *(unable to repeat)* *8*8. Refused 99. DK

Which of the two is a game? *(Bingo)*

1. YES *(Correct)* 0. NO *(incorrect)* *8*8. Refused 99. DK

Which is a kind of furniture? *(Chair)*

1. YES *(Correct)* 0. NO *(incorrect)* *8*8. Refused 99. DK

Now I'd like you to repeat two more words: Rabbit, Apple

1. YES *(able to repeat)* 0. NO *(unable to repeat)* *8*8. Refused

Which of the two is an animal? *(Rabbit)*

1. YES *(Correct)* 0. NO *(incorrect)* *8*8. Refused 99. DK

Which one is a type of fruit? *(Apple)*

1. YES *(Correct)* 0. NO *(incorrect)* *8*8. Refused 99. DK

I'm going to be coming back to these words a little later (3 to 5-minute delay).

Now I'd like to go back to those words you repeated earlier. Please recall as many of these words as you can.

Circle "2" for each word that is freely recalled. For any word not recalled, give category cue (game, furniture, animal, fruit). Circle "1" for that word if recalled with cue. If not recalled even with cue, circle "0" for that word.

	Freely Recalled	Cued Recall	Not retrieved	Refused
Bingo	2	1	0	88
Chair	2	1	0	88
Rabbit	2	1	0	88
Apple	2	1	0	88

APPENDIX C

CHAMPS QUESTIONNAIRE

CHAMPS ACTIVITY QUESTIONNAIRE

These next set of questions are about activities that you may have participated in the past 4 weeks. I'd like you to think about <u>how many</u> TIMES <u>a week</u> you usually did each activity and then tell me how many TOTAL HOURS <u>in a typical week</u> you did each activity.

A. **In a typical week during the past 4 weeks, did you …**	B. *(IF YES, go to Column C)*	C. **How many times a week?**	**D. How many TOTAL <u>hours a week</u> did you usually do it?**
1. **Visit with friends or family (other than those you live with)?**	1. YES 0. NO (go to 64) *88*. Refused 99. DK	*88*. Refused 99. DK	**1. < 1 hour 2. 1-2½ hours 3. 3-4½ hours** **4. 5-6½ hours 5. 7-8½ hours 6. 9 hours or more** *88*. Refused 99. DK
2. **Go to the senior center?**	1. YES 0. NO (go to 65) *88*. Refused 99. DK	*88*. Refused 99. DK	**1. < 1 hour 2. 1-2½ hours 3. 3-4½ hours** **4. 5-6½ hours 5. 7-8½ hours 6. 9 hours or more** *88*. Refused 99. DK
3. **Do volunteer work?**	1. YES 0. NO (go to 66) *88*. Refused 99. DK	*88*. Refused 99. DK	**1. < 1 hour 2. 1-2½ hours 3. 3-4½ hours** **4. 5-6½ hours 5. 7-8½ hours 6. 9 hours or more** *88*. Refused 99. DK
4. **Attend church or take part in church activities?**	1. YES 0. NO (go to 67) *88*. Refused 99. DK	*88*. Refused 99. DK	**1. < 1 hour 2. 1-2½ hours 3. 3-4½ hours** **4. 5-6½ hours 5. 7-8½ hours 6. 9 hours or more** *88*. Refused 99. DK
5. **Attend other club or group meetings?**	1. YES 0. NO (go to 68) *88*. Refused 99. DK	*88*. Refused 99. DK	**1. < 1 hour 2. 1-2½ hours 3. 3-4½ hours** **4. 5-6½ hours 5. 7-8½ hours 6. 9 hours or more** *88*. Refused 99. DK
6. **Use a computer?**	1. YES 0. NO (go to 69) *88*. Refused 99. DK	*88*. Refused 99. DK	**1. < 1 hour 2. 1-2½ hours 3. 3-4½ hours** **4. 5-6½ hours 5. 7-8½ hours 6. 9 hours or more** *88*. Refused 99. DK

A. **In a typical week during the past 4 weeks, did you …**	B. *(IF YES, go to Column C)*	C. **How many times a week?**	**D. How many TOTAL <u>hours a week</u> did you usually do it?**
7. **Dance (such as square, folk, line, ballroom) (do not count aerobic dance here)?**	1. YES 0. NO (go to 70) *8*8. Refused 99. DK	*8*8. Refused 99. DK	**1. < 1 hour 2. 1-2½ hours 3. 3-4½ hours** **4. 5-6½ hours 5. 7-8½ hours 6. 9 hours or more** *8*8. Refused 99. DK
8. **Do woodworking, needlework, drawing, or other arts or crafts?**	1. YES 0. NO (go to 71) *8*8. Refused 99. DK	*8*8. Refused 99. DK	**1. < 1 hour 2. 1-2½ hours 3. 3-4½ hours** **4. 5-6½ hours 5. 7-8½ hours 6. 9 hours or more** *8*8. Refused 99. DK
9. **Play golf, carrying or pulling your equipment (count walking time only)?**	1. YES 0. NO (go to 72) *8*8. Refused 99. DK	*8*8. Refused 99. DK	**1. < 1 hour 2. 1-2½ hours 3. 3-4½ hours** **4. 5-6½ hours 5. 7-8½ hours 6. 9 hours or more** *8*8. Refused 99. DK
10. **Play golf, riding a cart (count walking time only)?**	1. YES 0. NO (go to 73) *8*8. Refused 99. DK	*8*8. Refused 99. DK	**1. < 1 hour 2. 1-2½ hours 3. 3-4½ hours** **4. 5-6½ hours 5. 7-8½ hours 6. 9 hours or more** *8*8. Refused 99. DK
11. **Attend a concert, movie, lecture, or sport event?)?**	1. YES 0. NO (go to 74) *8*8. Refused 99. DK	*8*8. Refused 99. DK	**1. < 1 hour 2. 1-2½ hours 3. 3-4½ hours** **4. 5-6½ hours 5. 7-8½ hours 6. 9 hours or more** *8*8. Refused 99. DK
12. **Play cards, bingo, or board games with other people?**	1. YES 0. NO (go to 75) *8*8. Refused 99. DK	*8*8. Refused 99. DK	**1. < 1 hour 2. 1-2½ hours 3. 3-4½ hours** **4. 5-6½ hours 5. 7-8½ hours 6. 9 hours or more** *8*8. Refused 99. DK
13. **Shoot pool or billiards?**	1. YES 0. NO (go to 76) *8*8. Refused 99. DK	*8*8. Refused 99. DK	**1. < 1 hour 2. 1-2½ hours 3. 3-4½ hours** **4. 5-6½ hours 5. 7-8½ hours 6. 9 hours or more** *8*8. Refused 99. DK
14. **Play singles tennis (do not count doubles)?**	1. YES 0. NO (go to 77) *8*8. Refused 99. DK	*8*8. Refused 99. DK	**1. < 1 hour 2. 1-2½ hours 3. 3-4½ hours** **4. 5-6½ hours 5. 7-8½ hours 6. 9 hours or more** *8*8. Refused 99. DK

A. **In a typical week during the past 4 weeks, did you …**	B. *(IF YES, go to Column C)*	C. **How many times a week?**	**D. How many TOTAL <u>hours a week</u> did you usually do it?**
15. **Play doubles tennis (do not count singles)?**	1. YES 0. NO (go to 78) *88*. Refused 99. DK	*88*. Refused 99. DK	**1. < 1 hour** **2. 1-2½ hours** **3. 3-4½ hours** **4. 5-6½ hours** **5. 7-8½ hours** **6. 9 hours or more** *88*. Refused 99. DK
16. **Skate (ice, roller, in-line)?**	1. YES 0. NO (go to 79) *88*. Refused 99. DK	*88*. Refused 99. DK	**1. < 1 hour** **2. 1-2½ hours** **3. 3-4½ hours** **4. 5-6½ hours** **5. 7-8½ hours** **6. 9 hours or more** *88*. Refused 99. DK
17. **Play a musical instrument?**	1. YES 0. NO (go to 80) *88*. Refused 99. DK	*88*. Refused 99. DK	**1. < 1 hour** **2. 1-2½ hours** **3. 3-4½ hours** **4. 5-6½ hours** **5. 7-8½ hours** **6. 9 hours or more** *88*. Refused 99. DK
18. **Read?**	1. YES 0. NO (go to 81) *88*. Refused 99. DK	*88*. Refused 99. DK	**1. < 1 hour** **2. 1-2½ hours** **3. 3-4½ hours** **4. 5-6½ hours** **5. 7-8½ hours** **6. 9 hours or more** *88*. Refused 99. DK
19. **Do heavy work around the house (such as washing windows, cleaning gutters)?**	1. YES 0. NO (go to 82) *88*. Refused 99. DK	*88*. Refused 99. DK	**1. < 1 hour** **2. 1-2½ hours** **3. 3-4½ hours** **4. 5-6½ hours** **5. 7-8½ hours** **6. 9 hours or more** *88*. Refused 99. DK
20. **Do light work around the house (such as sweeping or vacuuming)?**	1. YES 0. NO (go to 83) *88*. Refused 99. DK	*88*. Refused 99. DK	**1. < 1 hour** **2. 1-2½ hours** **3. 3-4½ hours** **4. 5-6½ hours** **5. 7-8½ hours** **6. 9 hours or more** *88*. Refused 99. DK
21. **Do heavy gardening (such as spading, raking)?**	1. YES 0. NO (go to 84) *88*. Refused 99. DK	*88*. Refused 99. DK	**1. < 1 hour** **2. 1-2½ hours** **3. 3-4½ hours** **4. 5-6½ hours** **5. 7-8½ hours** **6. 9 hours or more** *88*. Refused 99. DK
22. **Do light gardening (such as watering plants)?**	1. YES 0. NO (go to 85) *88*. Refused 99. DK	*88*. Refused 99. DK	**1. < 1 hour** **2. 1-2½ hours** **3. 3-4½ hours** **4. 5-6½ hours** **5. 7-8½ hours** **6. 9 hours or more** *88*. Refused 99. DK

A. **In a typical week during the past 4 weeks, did you …**	B. *(IF YES, go to Column C)*	C. **How many times a week?**	**D. How many TOTAL <u>hours a week</u> did you usually do it?**
23. **Work on your car, truck, lawn mower, or other machinery?**	1. YES 0. NO (go to 86) *88*. Refused 99. DK	*88*. Refused 99. DK	**1. < 1 hour 2. 1-2½ hours 3. 3-4½ hours** **4. 5-6½ hours 5. 7-8½ hours 6. 9 hours or more** *88*. Refused 99. DK
24. **Jog or run?**	1. YES 0. NO (go to 87) *88*. Refused 99. DK	*88*. Refused 99. DK	**1. < 1 hour 2. 1-2½ hours 3. 3-4½ hours** **4. 5-6½ hours 5. 7-8½ hours 6. 9 hours or more** *888*. Refused 99. DK
25. **Walk uphill or hike uphill (count only uphill part)?**	1. YES 0. NO (go to 88) *88*. Refused 99. DK	*88*. Refused 99. DK	**1. < 1 hour 2. 1-2½ hours 3. 3-4½ hours** **4. 5-6½ hours 5. 7-8½ hours 6. 9 hours or more** *88*. Refused 99. DK
26. **Walk fast or briskly for exercise (do not count walking leisurely or uphill)?**	1. YES 0. NO (go to 89) *88*. Refused 99. DK	*88*. Refused 99. DK	**1. < 1 hour 2. 1-2½ hours 3. 3-4½ hours** **4. 5-6½ hours 5. 7-8½ hours 6. 9 hours or more** *88*. Refused 99. DK. Refused
27. **Walk to do errands (such as to/from a store or to take children to school (count walk time only)?**	1. YES 0. NO (go to 90) *88*. Refused 99. DK	*88*. Refused 99. DK	**1. < 1 hour 2. 1-2½ hours 3. 3-4½ hours** **4. 5-6½ hours 5. 7-8½ hours 6. 9 hours or more** *88*. Refused 99. DK
28. **Walk leisurely for exercise or pleasure?**	1. YES 0. NO (go to 91) *88*. Refused 99. DK	*88*. Refused 99. DK	**1. < 1 hour 2. 1-2½ hours 3. 3-4½ hours** **4. 5-6½ hours 5. 7-8½ hours 6. 9 hours or more** *88*. Refused 99. DK
29. Ride a bicycle or stationary cycle?	1. YES 0. NO (go to 92) *88*. Refused 99. DK	*88*. Refused 99. DK	1. < 1 hour 2. 1-2½ hours 3. 3-4½ hours 4. 5-6½ hours 5. 7-8½ hours 6. 9 hours or more *88*. Refused 99. DK

A. In a typical week during the past 4 weeks, did you …	B. *(IF YES, go to Column C)*	C. How many times a week?	D. How many TOTAL <u>hours a week</u> did you usually do it?
30. Do other aerobic machines such as rowing, or step machines (do not count treadmill or stationary cycle)?	1. YES 0. NO (go to 93) *88*. Refused 99. DK	*88*. Refused 99. DK	**1. < 1 hour 2. 1-2½ hours 3. 3-4½ hours** **4. 5-6½ hours 5. 7-8½ hours 6. 9 hours or more** *88*. Refused 99. DK
31. Do water exercises (do not count other swimming)?	1. YES 0. NO (go to 94) *88*. Refused 99. DK	*88*. Refused 99. DK	**1. < 1 hour 2. 1-2½ hours 3. 3-4½ hours** **4. 5-6½ hours 5. 7-8½ hours 6. 9 hours or more** *88*. Refused 99. DK
32. Swim moderately or fast?	1. YES 0. NO (go to 95) *88*. Refused 99. DK	*88*. Refused 99. DK	**1. < 1 hour 2. 1-2½ hours 3. 3-4½ hours** **4. 5-6½ hours 5. 7-8½ hours 6. 9 hours or more** *88*. Refused 99. DK
33. Swim gently?	1. YES 0. NO (go to 96) *88*. Refused 99. DK	*88*. Refused 99. DK	**1. < 1 hour 2. 1-2½ hours 3. 3-4½ hours** **4. 5-6½ hours 5. 7-8½ hours 6. 9 hours or more** *88*. Refused 99. DK
34. **Do stretching or flexibility exercises (do not count yoga or Tai-chi)?**	1. YES 0. NO (go to 97) *88*. Refused 99. DK	*88*. Refused 99. DK	**1. < 1 hour 2. 1-2½ hours 3. 3-4½ hours** **4. 5-6½ hours 5. 7-8½ hours 6. 9 hours or more** *88*. Refused 99. DK
35. **Do yoga or Tai-chi?**	1. YES 0. NO (go to 98) *88*. Refused 99. DK	*88*. Refused 99. DK	**1. < 1 hour 2. 1-2½ hours 3. 3-4½ hours** **4. 5-6½ hours 5. 7-8½ hours 6. 9 hours or more** *88*. Refused 99. DK
36. **Do aerobics or aerobic dancing?**	1. YES 0. NO (go to 99) *88*. Refused 99. DK	*88*. Refused 99. DK	**1. < 1 hour 2. 1-2½ hours 3. 3-4½ hours** **4. 5-6½ hours 5. 7-8½ hours 6. 9 hours or more** *88*. Refused 99. DK

A. **In a typical week during the past 4 weeks, did you …**	B. *(IF YES, go to Column C)*	C. **How many times a week?**	**D. How many TOTAL <u>hours a week</u> did you usually do it?**
37. **Do moderate to heavy strength training (such as hand-held weights of more than 5 lbs., weight machines, or push-ups)?**	1. YES 0. NO (go to 100) *88*. Refused 99. DK	*88*. Refused 99. DK	**1. < 1 hour 2. 1-2½ hours 3. 3-4½ hours** **4. 5-6½ hours 5. 7-8½ hours 6. 9 hours or more** *88*. Refused 99. DK
38. **Do light strength training (such as hand-held weights of 5 lbs. or less or elastic bands)?**	1. YES 0. NO (go to 101) *88*. Refused 99. DK	*88*. Refused 99. DK	**1. < 1 hour 2. 1-2½ hours 3. 3-4½ hours** **4. 5-6½ hours 5. 7-8½ hours 6. 9 hours or more** *88*. Refused 99. DK
39. **Do general conditioning exercises, such as light calisthenics or chair exercises (do not count strength training)?**	1. YES 0. NO (go to 102) *88*. Refused 99. DK	*88*. Refused 99. DK	**1. < 1 hour 2. 1-2½ hours 3. 3-4½ hours** **4. 5-6½ hours 5. 7-8½ hours 6. 9 hours or more** *88*. Refused 99. DK
40. **Play basketball, soccer, or racquetball (do not count time on sidelines)?**	1. YES 0. NO (go to 103) *88*. Refused 99. DK	*88*. Refused 99. DK	**1. < 1 hour 2. 1-2½ hours 3. 3-4½ hours** **4. 5-6½ hours 5. 7-8½ hours 6. 9 hours or more** *88*. Refused 99. DK
41. **Do other types of physical activity not previously mentioned (please specify)?** **_____** **_____**	1. YES 0. NO (go to 104) *88*. Refused 99. DK	*88*. Refused 99. DK	**1. < 1 hour 2. 1-2½ hours 3. 3-4½ hours** **4. 5-6½ hours 5. 7-8½ hours 6. 9 hours or more** *88*. Refused 99. DK. Refused 9

APPENDIX D

RECRUITMENT GUIDE (STUDY 2)

ID ___ ___ ___ ___ **DATE ___ ___ / ___ ___ / 2 0 12**

Recruitment Guide

Hi, this is Jason Flatt from the Falls-Free PA Study and the University of Pittsburgh. I am calling because you mentioned you might be interested in participating in a research study I'm doing on the role of social activities in late life. This research study is being conducted as part of my graduate school training. Approximately 20 individuals, who all participated in the Falls-Free PA Study and live in Allegheny County, are being invited to participate.

If you agree to participate, you will participate in a one-time interview that will last about 1 to 1 ½ hours. The interview can be held at your home or another public space. As part of the interview, you will be asked about the types of social activities you do, why you participate in them and the potential benefit that these activities might have for your health and memory. There are no costs to you for participating in this research study, and you will receive no direct benefit from participation. You will receive $20 as a thank you for your participation.

There is little risk involved in this research study. No invasive procedures or medications are included. The major potential risk associated with your participation is that you may experience frustration or anxiety with some of the questions asked of you, but we will do everything possible to minimize any discomfort. There is also a potential risk of a breach of confidentiality, but we will do everything possible to protect your privacy. Any information about you obtained from this research will be kept as confidential (private) as possible. All records related to your involvement in this research study will be stored in a locked file cabinet. Your identity on these records will be indicated by a case number rather than by your name, and

the information linking these case numbers with your identity will be kept separate from the research records. You will not be identified by name in any publication of the research results.

Your participation in this research study is completely voluntary. Participation in this research study is separate from your part in the Falls-Free PA study, and your decision to be, or not be, a part of this research study will have will not affect your relationship with the University of Pittsburgh or University of Pittsburgh Medical Center. We will, however, have access to the information we have gathered about you as part of the Falls-Free PA study. Any comments that you make during the interviews will not be linked to your personal information.

Do you have any questions? Are you willing to participate?

No _____ Okay, Thank you for your time.

Yes _____ Great, let's discuss some dates to for the interview. Ok, great I will see you on DATE ___ ___ / ___ ___ / 2 0 1 2 and TIME: _____. If you need to reach me, you can call me at 412-624-3612.

APPENDIX E

INTERVIEWING GUIDE (STUDY 2)

Introduction

The purpose of this interview is to find out about activities that you enjoy doing with others. I'm really interested in the activities that you do with others because you find them enjoyable and really want to do them. I'm also interested in whether activities you do with others are important for your memory and keeping your mind active. If you don't mind, I'd like to tape our conversation. This is so I can really listen to you, rather than focus on taking notes. You are the expert and I am interested in learning from you. I will ask a few general questions, but please feel free to talk about anything that you feel is important, even if I don't ask about it. I'd like to be more of a casual conversation between the two of us rather than a formal interview. Please let me know if you need or want to take a break at any time. Do you have any questions? Let's begin.

1. Let's start with you telling me a little bit about yourself.
    a. Probe: What type of work do/did you do?
    b. Probe: Have you always lived in the area?
    c. Probe: Does your family live nearby?
2. Tell me a little bit about how you spend your time? (A typical day or your routine)
    a. Probe: How about the people you enjoy spending time with?
    b. Prove: Are these friends or family members?
3. If you could pick a favorite activity to do with others, what would it be?
    a. Probe: Why?
4. What other types of activities do you enjoy doing with others?
    a. How about having people over for a meal?

b. How about traveling or visiting someone's home?

c. How about going out somewhere with someone (e.g., restaurant, movie, theater, or sports)

d. How about joining others for conversation, to play games, etc.

e. Are there any others?

5. What do you enjoy most about doing these activities?
6. Why do you keep doing these activities?
    a. Probe: Is there anything else that motivates you to do them?
    b. Probe: What do you think others get out of them?
7. What about them do you find stimulating?
    a. Probe: Do you think these activities help to keep your mind active or memory sharp?
8. What types of things get in the way of you being able to do these activities?
9. What do you do when others are not available to do the activities with you?
10. Say you could spend a day doing anything you wanted. Money, time, and health are no object. How would you spend your day?
    a. Probe: Why? (If necessary)

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