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The association between Internet use and characteristics of social networking for middle aged and older adults

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by

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ABSTRACT

Background: Studies have shown that strong social networks have a positive effect on physical and psychological well-being. Research suggests that Internet use may affect social networks. However it is not clear if Internet use has a positive or negative effect on social networks. One theory suggests that Internet use displaces face-to-face contacts and off line social participation. Another theory suggests Internet use replaces high quality face-to-face ties with weaker online ties. Other studies however suggest the Internet has a positive effect on social networks. Because older adults have shrinking social networks, but may have more discretionary time than other age groups, the Internet may be a tool that can be used to strengthen social networks for this age group.

Methods: This study uses a sample from the 2004 wave of the Health and Retirement Survey to assess the association between Internet use and social networks. Age is tested for moderation of the association between Internet use and social networks. Oversampling and design effects of the sample are accounted for using weights and special procedures in SAS version 9.1. Univariate, bivariate and linear regression analyses are employed for the examination of associations and moderation.

Results: In regression models (n=2,284) considering a number of control variables, frequency of contact with friends, frequency of contact with family, and attendance at

organizational meetings (not including religious services), were found to have a significant positive association with Internet use, while in-person contact with family members (other than children) had a significant negative association with Internet use. Age was not found to moderate any of the significant associations between Internet use and measures of social networking.

Conclusions: Results suggest the Internet could be used as a tool in interventions designed to strengthen social networks for older adults and that policies to increase the availability of the Internet should be considered. Internet use is not associated with a decrease in social participation based on attendance of religious services or other organizations. The amount of time spent on Internet use is not considered in this study and is a limitation.

Introduction

Scope of the Problem

Available evidence suggests that strong social networks help manage stress, reduce depression, and improve health outcomes (Berkman, 1985; Cohen & Syme, 1985; Crawford, 1987; Lubben & Gironda, 1996; Seeman, 1996). It also appears that the Internet is transforming the way people communicate, and may affect social networks (Bargh & McKenna, 2004; Coget, Yamauchi, & Suman, 2002; Katz & Aspden, 1997; Kraut et al., 2002; Kraut et al., 1998; Nie & Hillygus, 2002). The literature contains contradictory studies on how Internet use may influence social networks. Some studies suggest that the Internet distracts users from their real life social networks, thereby weakening their social ties (Kraut et al., 1998; Nie & Hillygus, 2002). They point to the Internet paradox where people communicate more, yet their social networks suffer because of reduced off-line social interaction. Other studies suggest that the Internet helps people create new social ties and strengthen social networks (Katz & Aspden, 1997; Kraut et al., 2002).

The Pew Internet & American Life Project found that in the United States 88% of 18-29 year-olds, 84% of 30-49 year-olds, 71% of 50-64 year-olds, and 34% of those 65 and older went online in January 2006 (Fox, 2006). In 2004, only 22% of Americans 65 and older went online (Fox, 2004). Because few older adults use the Internet, there is a dearth of studies concerning the influence Internet use may have on their social networks.

Considering the challenges older adults face in maintaining a strong social network, including reduction in network size, reduced mobility, and health problems associated with aging, the Internet may be of use in strengthening their social network. Older adults have more discretionary time than other age groups (Moss & Lawton, 1982), and may, therefore, not have the time constraints younger age groups face concerning Internet use and off-line social participation.

Purpose of Study

The problem considered in this study is whether or not the Internet can be used as a tool to strengthen the social networks of older adults. To make that determination the association between Internet use and social networks for older adults must be examined. It is not clear in the literature if use of the Internet strengthens social ties, or weakens them. There may be differences between the older adults and other age groups based on employment status, family stage, and health status. This study adds to the body of literature on social networking by examining the association between Internet use and characteristics of social networks of middle aged and older adults (51 years or older). To account for potential differences in age groups, age is examined as a potential moderator of the association between Internet use and social networks.

Review of Literature

Social Networks

Social networks are linkages between people that may provide social support (Heaney & Israel, 2002). Structural network characteristics may explain support, access to jobs, social influence, and health behaviors (Berkman & Glass, 2000). Whereas social networks are the structural aspects of social integration, social support is the functional aspect (Lubben & Gironda, 1996).

Social networks consist of elements that describe the network as a whole, and characteristics of the social ties that comprise the network. Social network structures include size, reciprocity, complexity, density, boundedness, homogeneity, reachability, and geographic dispersion (Berkman & Glass, 2000; Hall & Wellman, 1985; Heaney & Israel, 2002; Lubben & Gironda, 1996). Characteristics of network ties include frequency of contacts, frequency of organizational participation, reciprocity of ties, multiplexity, duration, and intimacy (Berkman & Glass, 2000; Hall & Wellman, 1985).

Table 1, adapted from Berkman and Glass (2000), shows the linkages among social networks, social support, and health. Through this conceptual model, Berkman and Glass show how social networks provide opportunities for psychosocial mechanisms, such as social support and social influence, which in turn impact health through health behavioral, psychological, and physiologic pathways.

Table 1: Excerpts of the conceptual models by Berkman & Glass (2000) of how social networks impact health

Social Networks	>>	Psychosocial Mechanisms	>>	Pathways
Social network structure: o Size o Range o Density o Boundedness o Proximity o Homogeneity o Reachability	Which provide opportunities for…	Social Support: o Instrumental & financial o Informational o Appraisal o Emotional	Which impact health through these…	Health behavioral pathways: o Smoking o Alcohol consumption o Diet o Exercise o Adherence to medical treatments o Help-seeking behavior
Characteristics of network ties: o Frequency of face-to-face contact o Frequency of nonvisual contact o Frequency of organizational participation (attendance) o Reciprocity of ties o Multiplexity o Duration o Intimacy		Social influence: o Constraining/enabling influences on health behaviors o Norms toward help-seeking/adherence o Peer pressure o Social comparison process		Psychological pathways: o Self-efficacy o Coping effectiveness o Depression/distress o Sense of well-being
		Social Engagement o physical/cognitive exercise o Reinforcement of meaningful social roles o Bonding/ interpersonal attachment		Physiologic pathways: o HPA axis response o Allostatic load o Immune system function o Cardiovascular reactivity o Cardiopulmonary fitness o Transmission of infectious disease

Theories on Social Networks and Health

There are many theories that suggest strong social networks have positive effects on health outcomes and psychological well-being. The stress-buffering hypothesis suggests that strong social ties reduce the susceptibility of individuals to stress-related illnesses (Lubben & Gironda, 1996). Another theory suggests that social isolation may have a physiologic effect on elders, such as impacting immune or cardiovascular functioning (Berkman, 1985; Seeman, 1996). Yet another theory suggests that health promotion behaviors of the elderly can be affected by a strong social support network because of the encouragement that it can provide (Crawford, 1987). During times of illness, social networks provide support that contribute to better adaptation and

accelerated recovery time (Cohen & Syme, 1985). According to Seeman (1996) many studies suggest an association between social integration and mortality risk from all causes. Decreasing levels of social integration may be associated with increasing mortality risk (Seeman, 1996).

Not only do social networks affect health, but health status affects one's ability to maintain a social network (Heaney & Israel, 2002). In addition to affecting individual health, there is evidence that social network building within communities is associated with enhanced community capacity (Heaney & Israel, 2002).

The Internet and Social Networks

The Internet is affecting the way people communicate and interact (Bargh & McKenna, 2004; Coget et al., 2002; Katz & Rice, 2002). Some authorities argue that this communication transformation has an impact on characteristics of social networks (Bargh & McKenna, 2004; Coget et al., 2002; Kraut et al., 2002; Kraut et al., 1998; Nie & Hillygus, 2002). Studies show that Internet use may have a negative impact on social networks such as declines in face-to-face communication with family and smaller social circles, damage to social interaction with family members, or may lead to depression and isolation (Kraut et al., 1998; Nie & Hillygus, 2002). This phenomenon has been coined "the Internet paradox" (Kraut et al., 1998) because people use the Internet for communication, and communication generally has a positive effect on social involvement. Other studies suggest Internet use does not increase social isolation, but is a source of civic organizational involvement, new personal friendships, and has positive effects on communication, social involvement, and well-being (Katz & Aspden, 1997; Kraut et al., 2002). The level of influence that Internet use has on a person's social network may

depend upon the quality of their Internet relationships or what they give up to spend time online (Kraut et al., 2002).

Older Adults, Social Networks, and the Internet

Older adults, those over the age of 64, spend the majority of their discretionary time at home, and they have more discretionary time than persons of younger age groups (Moss & Lawton, 1982). Moreover, they often report problems with isolation, loneliness, and boredom (Neugarten, 1977). The reduction of social contact due to retirement, death of family members and friends, or residential relocation are, in part, causes of decreasing social networks of older adults (Havens, Hall, Sylvestre, & Jivan, 2004; Pillemer & Glasgow, 2000). The disengagement theory suggests that older adults withdraw from social roles, but critics suggest that disengagement may occur due to lack of opportunity for a meaningful role (Pillemer & Glasgow, 2000).

The evidence of decreasing social network strength suggests that older adults are at risk for becoming socially isolated. Pillemer and Glasgow (2000) argue that baby-boomers may be at higher risk due to lower marriage rates, higher rates of divorce, and fewer offspring. In addition, the length of time an older adult may be without a meaningful role could be increasing with the current trends of earlier retirement, increasing longevity and improving health status (Pillemer & Glasgow, 2000).

Some authorities report that e-mail allows older adults to feel less isolated from their family, better informed about health issues, and more socially connected (Malcolm et al., 2001). Similarly, older adults who participate in online forums and use e-mail feel less isolated and more connected (Lawhon, Ennis, & Lawhon, 1996). Retired older adults find roles in online forums by sharing their knowledge and skills (Lawhon et al.,

1996). For older adults to take advantage of the Internet, they need to be aware of its capabilities and be able to develop a basic knowledge of computers. Interactive multimedia computer technology can be effective in teaching important information to older adults (Mercer, Chiriboga, & Sweeney, 1997). Researchers also suggest that older adults are capable and willing to learn how to use new computer technologies (Malcolm et al., 2001), and that most participants feel less anxious and more confident about using computer technology after training (Irizarry, Downing, & West, 2002).

Conceptual Framework and Hypothesis

The literature demonstrates that a strong social network impacts health and health outcomes (Berkman, 1985; Cohen & Syme, 1985; Crawford, 1987; Lubben & Gironda, 1996; Seeman, 1996). Social networks may become smaller as people grow older, providing fewer contacts that offer social support (Havens et al., 2004). Whereas some studies suggest that Internet use may increase the strength of the social networks by increasing the number of ties and frequency of contacts, other studies have shown that Internet use may have a negative effect on social networks by reducing the amount of time people spend on social activities (Bargh & McKenna, 2004; Coget et al., 2002; Katz & Aspden, 1997; Kraut et al., 2002; Kraut et al., 1998; Nie & Hillygus, 2002). This thesis adds to the body of literature that reports on social networks by investigating the association between Internet use and social networks for middle aged and older adults.

One theory that looks at Internet use and social networks contends that Internet use replaces high quality face-to-face ties with weaker online ties (Coget et al., 2002; Kraut et al., 1998). One way to evaluate this possible association is by measuring the number of confidants and the number of close ties reported. A second theory suggests that Internet use displaces social activities in that time spent on the Internet is not available for other activities (Coget et al., 2002; Kraut et al., 1998; Nie & Hillygus, 2002). If this displacement phenomenon is the case, there should be a reduction of participation in organizations and face-to-face contacts for Internet users.

This study first investigates the null hypothesis that, for U.S. adults 51 years and older, there is no difference between Internet users and non-users with regard to the quality of their social ties. The alternative hypothesis is that, for U.S. adults 51 years of age and older, the quality of social ties for Internet users will differ from that of non-users of the Internet. If the null hypothesis is rejected, further investigation may suggest that Internet use replaces high quality social ties with weaker ones.

- *Research Question 1*: Do Internet users report fewer close social ties (family or friends), confidants, or contacts with close ties than do non-users of the Internet?

The second null hypothesis is that for U.S. adults 51 years and older, there is no difference between Internet users and non-users with regard to frequency of in-person social contact. The alternative hypothesis is that, for U.S. adults 51 years and older, the frequency of in-person social contact for Internet users differs from that of non-users of the Internet. If the null hypothesis is rejected, further investigation may show that Internet use does reduce time available for in-person social participation.

- *Research Question 2*: Do Internet users report less participation in organizations, attend religious services less often, or have fewer meetings with close friends and family than do non-users of the Internet?

The final null hypothesis in this study is that in the U.S., age does not moderate the association between Internet use and social networks for adults 51 and older. The alternative hypothesis is that in the U.S., the association between Internet use and social networks for adults 51 years and older is moderated by age. Some studies suggest time spent on the Internet is time away from family, friends, and participating in organizations,

thereby reducing social integration (Kraut et al., 1998; Nie & Hillygus, 2002). Those time restrictions may not be the case for older adults who have more discretionary time than younger adults (Moss & Lawton, 1982).

- *Research Question 3*: Does age moderate the association between Internet use and the number of close family, number of close friends, contacts with close friends, contacts with family, confidants, participation in organizations, or attendance of religious services?

Characteristics commonly used in studies that look at network structure are the number of close friends and relatives, marital status, frequency of contact with family and friends, confidants, and frequency of attendance at religious and voluntary associations, race, gender, income, education, age, and living situation, (Berkman & Glass, 2000; Oxman & Berkman, 1990; Seeman, 1996; Seeman & Berkman, 1988). This study uses similar measures to evaluate the stated hypotheses.

Methods

Sample

Data for this study were collected from the 2004 wave of the *Health and Retirement Study*, a nationally representative, longitudinal study. The University of Michigan Health and Retirement Study (HRS), supported by the National Institute on Aging (NIA U01AG009740), surveys more than 22,000 Americans over the age of 50 in the contiguous United States every two years (Heeringa & Connor, 1996). The HRS studies the later life course and collects detailed information about the respondent's demographic background, health, employment, family relationships, income and wealth. The sample was selected under a multi-stage area probability sample design (Heeringa & Connor, 1996). The study design also included supplemental oversamples of African Americans, Hispanics and residents of the state of Florida (Heeringa & Connor, 1996). The data collection period for the 2004 interview was March 2004 through February 2005. Institutionalized persons (i.e., those in prisons, jails, nursing homes, long-term or dependent care facilities) were excluded from the survey population (Heeringa & Connor, 1996). The HRS 2004 Core Final Release contains data for 20,129 respondents, in 13,645 households (*2004 HRS final core code book*, 2006).

Each wave of the HRS also includes additional modules that are asked only of a portion of the sample. The modules contain questions of interest for a specific research issue. The 2004 Psychosocial Leave-Behind (PLB) module asked questions about

loneliness and social support. The PLB module was administered to a random sample of respondents who received interviews in the 2004 survey (*HRS data description and usage*, 2006). The final PLB module dataset contains 3,273 records (*2004 HRS final core code book*, 2006). All of the measures for social networking in this study were gathered from the PLB module.

Data were also collected from the RAND HRS Data file, version F. The RAND HRS file is a cleaned version of data from nine waves of the Health and Retirement Study data. Derived variables covering a broad range of measures have been constructed for this dataset. Version F incorporates data from 1992, 1993, 1994, 1995, 1996, 1998, 2000, and 2002 final releases, and the 2004 early release of HRS data (*RAND Contributions: RAND HRS Data File (v.F)*, 2006). The file was developed by the RAND Center for the Study of Aging with funding from the National Institute on Aging and Social Security Administration. The file incorporates only the core interviews.

Data from the 2004 HRS PLB module data set were merged with data from the core 2004 HRS datasets, the 2004 Cross-Wave Tracker file, and the RAND HRS data file version F, using household ID and person ID numbers to create a master data file for this study. The 2004 HRS Cross-Wave Tracker v.1.0 (January 2007) contains variables (stratum, secu, jwgtr) used to account for the complex sampling design and oversampling used in the HRS. Only variables to be used in this study were included from each file in the merges. The master dataset file contained only respondents that participated in the 2004 HRS Psychosocial Leave-Behind module and consisted of 3,273 cases in 56 strata and 111 clusters.

Measures

Measures used in this study are detailed in appendix A. The dependent variables are measures of social networking characteristics that are examined in theories that explain Internet effects on social networks. These variables include measures of network size, confidants, frequency of contact with friends and family, and organization attendance. Internet use is the independent variable of interest and is investigated for associations with characteristics of social networks. Age is examined as a potential moderator of the association between Internet use and measures of social networking. Control variables include measures commonly used in investigations of social network structures and Internet use including marital status, race, ethnicity, gender, income, education, living status, current employment status, occupation, number of children, and health status.

The size of a social network is one of the most commonly used variables when looking at social networks (Litwin, 1996). Some studies argue that the quantity of contacts may be associated with risk of dying (Mullins., Elston, & Gutkowski, 1996). Other studies suggest that network size is not as important as *quality* of ties and that larger networks may bring increased demands and potential for damaging interactions (Stokes, 1983). Kraut et al. (1998) suggests that Internet users replace in-person contact with online virtual relationships, and that online relationships are not as deep as off-line relationships. This supposed lack of depth effectively reduces the quality of relationships while possibly increasing breadth. This study looks at the number of close relationships each respondent has by asking participants to estimate the number of close relationships they have with children, other family, and friends.

Some studies have suggested that having at least one confidant may be the most important indicator of a supportive social network (Stokes, 1983). However, the literature on the Internet and confidants is mixed. There are studies that suggest relationships created or primarily maintained online are lower quality than those maintained by other means (Cummings, Lee, & Kraut, 2006). Other studies argue online relationships can be as strong as those developed by other means given enough time (Cummings et al., 2006). This study looks at confidants reported by respondents. Respondents were asked how much they can "open up to" and "talk about your worries" with their spouse/partner, children, other family, and friends. Responses are measured on a four-point scale from "not at all" to "a lot."

There is debate in the literature whether or not Internet use increases contact with family and friends, or reduces the time available for such contacts (Coget et al., 2002; Kraut et al., 1998; Nie & Hillygus, 2002). Studies are also mixed about whether Internet use increases or decreases the number of in-person contacts with family and friends (Katz & Rice, 2002; Kraut et al., 1998; Nie & Hillygus, 2002). Frequency of contact is examined in this study by asking respondents how often they have contact with family and friends either in-person, by phone, or by mail or email. All forms of contact are measured on a six-point scale ranging from "less than once a year or never" to "three or more times a week." In-person contact is also examined separately by looking specifically at how often respondents reported meeting with family and friends.

Participation in social groups is measured by studying religious services attendance and participation in meetings other than religious services. One theory suggests participation in social groups is being replaced by time spent online (Kraut et al.,

1998; Nie & Hillygus, 2002). Some studies suggest Internet users are more likely to belong to religious, leisure, and community organizations (Bargh & McKenna, 2004; Katz, Rice, & Aspden, 2001). This study looks at attendance of religious services measured on a five-point scale ranging from "not at all" to "more than once a week." Attendance in leisure or community meetings (not including attendance of religious services) is examined using a six-point scale ranging from "never" to "more than once a week."

Internet use is a dichotomous variable in the dataset and age is a continuous variable. Internet use is defined in the HRS survey as regular use of the World Wide Web, or the Internet, for sending and receiving e-mail or for any other purpose, such as making purchases, searching for information, or making travel reservations.

Age is the reported age of the respondent at the time of the interview. Respondents range from 51 to 101 years of age. The association between Internet use and social networking measures may vary at different ages, thus age is explored as a potential moderator.

A number of control measures are included in this study based on controls used in other studies on Internet use and social networks. Control measures include marital status, race, ethnicity, gender, income, education, living status, current employment status, occupation, having children, and health status. These variables were selected as control measures because it has been suggested they may be related to Internet use and the dependent variables (Coget et al., 2002; Fox, 2006; Glass, F., Seeman, & Berkman, 1997; Levy et al., 2000; Nie & Hillygus, 2002).

Marital status is a dichotomous variable with one value indicating the respondent is currently married or partnered and the other not married. Race has three values, Caucasian, African American, or other. Ethnicity is a dichotomous variable with a value for Hispanic and the other for non-Hispanic. Gender is given by the respondent at the time of the interview and is a dichotomous variable with values for male or female. Income is a variable that is the total household income in dollars for the respondent and spouse and is calculated in the Rand dataset using a number of variables from the 2004 HRS core data. Education is an interval level variable that holds the number of years of education the respondent has completed, with 17 being the highest possible value, representing graduate education level. Living status is an interval level variable that tracks the number of people living in the respondent's home. A variable to track if the respondent had any children was dichotomous with values for yes and no. Current employment status is dichotomous with values for currently working and not currently working.

Occupation of longest tenure was coded into three categories. White and blue collar occupation categories were coded using the same method as other studies using the HRS dataset and the occupation variable (Bovbjerg, 1998; Wu & Prorell, 2000). Managerial, professional specialty/technical support, sales, and clerical/administrative support occupations were classified as white collar. Cleaning/building services, protection services, food preparation services, health services, personal services, farming/forestry/fishing, mechanics/repair, construction trade, precision production, machine operators, transport operators and handlers occupations were classified as blue

collar. Respondents in the armed forces or missing data for occupation were categorized as unknown.

It has been suggested that social networks and health have a reciprocal relationship. Supportive ties may enhance well-being and health, and health status may influence the size and strength of a social network one is able to maintain (Heaney & Israel, 2002). Health status may also affect Internet use. Bargh and McKenna (2004) discuss the possibility that those who suffer from a stigmatized illness or lack of mobility may be especially likely to turn to the Internet. Two self-report measures were selected for health status. Health status is reported on a five-point scale ranging from excellent to poor. Health barriers measure how often health stops the respondent from doing things they want to do, measured on a four-point scale from often to never.

Statistical Analysis

This analysis examines the dataset constructed from the HRS data for associations between Internet use and measures of social networking, while controlling for certain demographic, health, and occupation variables. The potential for moderation by age is also examined.

All of the analysis was run on SAS version 9.1. Variables from the tracker file were used to account for the complex sampling design and oversampling including a respondent level weight variable (jwgtr), strata variable (stratum), and the stratum half-sample code variable (secu). The stratum and secu variables used in conjunction with specialized SAS survey procedures to account for the complex random sample design effects of the HRS sample. Sample weights were normalized (relative) to the size of the dataset used. For analysis of the PLB sample of the 2004 HRS, weights were normalized

to the 3,273 cases in that dataset. For analysis of the final dataset, weights were normalized to the 2,284 cases retained. SAS has no tools to adjust weights based on reduction of sample size (due to excluded cases).

Before the final sample for study was created, some variables were manipulated to reduce missing data. Data that were missing from the PLB module dataset were cross-checked with other variables from within that dataset as well as from the HRS Core, Tracker, and RAND data. The missing data in the PLB dataset were replaced if valid data were found in other datasets. As an example, if a case in the PLB dataset was missing data for "number of children", and another dataset had data that stated the respondent had no children, then the "number of children" variable was updated from missing to zero. Some variables were reverse coded to facilitate interpretation. Appendix A details modifications to data.

To decrease the number of social networking variables, it was proposed that some variables be combined. However, due to weak Cronbach α values, the only variables that were combined were frequency of contact measures. The two new variables created were "contact with family" ($\alpha = 0.69$) and "contacts with friends" ($\alpha = 0.71$). The forms of contacts combined were in-person meetings, contact by phone, and contact by mail or email. There is some evidence that Internet use may affect interactions with close family differently than with friends (Cummings et al., 2006). In addition, some studies suggest friends and family may provide different levels of support (Fiori, Toni, & Cortina, 2006). Litwin reports that older adults generally have more frequent contact with family members than friends (Litwin, 1996). For these reasons, measures of family are separated from measures of friends.

Univariate analysis revealed some variables with large kurtosis values. These variables all had a few cases with values far greater than their mean. To reduce their kurtosis value and bring them to a more normal distribution their values were truncated at their 95th percentile. Variables truncated were “number of close other family” (95th percentile =12), “number of close friends” (95th percentile =14), “household residents” (95th percentile =4), “household income” (95th percentile =187500). Because there were an unusual number of cases missing data for "occupation" (359 weighted cases), missing data were recoded to "unknown." Most cases in the new category of “unknown” had a current job status of retired, homemaker, or were in the Armed Forces.

To determine correlations between interval level variables and other interval or dichotomous variables, the *surveyreg* procedure in SAS was used. The correlations were calculated using the square root of the R-squared value of simple regression models (one dependent, one independent variable) resulting in Spearman rank correlations for interval level independent variables, and point-biserial correlation for dichotomous independent variables. Where the independent variable was a categorical variable with more than two categories, dummy coded variables were used in the model and the Eta was derived. To determine bivariate associations between categorical variables, the SAS procedure *surveyfreq* was used to determine the chi-square value. Cramer’s *V* was calculated from the results. SAS procedures used were capable of using variables included in the HRS dataset (stratum, secu, jwgtr) to take into account the complex sampling design and oversampling used in the HRS sample.

Cases missing data in variables to be used in the bivariate and regression tests or with non-positive weights were then dropped from the dataset. Those cases retained were

compared to those dropped. Seventy percent (n=2284) of the cases from the PLB dataset were retained. There was no significant difference in work status $\chi^2(1, N=3273) = 3.02$, $p = .232$, or gender, $\chi^2(1, N=3273) = 3.718$, $p = .0547$ between the two sets. Measures with statistically significant differences, but small effect sizes, between retained and dropped cases were race, $\chi^2(2, N=3269) = 29.509$, $p < .0001$, marriage status, $\chi^2(1, N=3273) = 7.10$, $p = .0350$, have children, $\chi^2(1, N=3261) = 22.03$, $p=.0001$, Hispanic, $\chi^2(1, N=3272) = 43.94$, $p<.0001$, Internet use, $\chi^2(1, N=3155) = 60.34$, $p<.0001$, age, r_{pb} (56)=.1178, $p<.0001$, household residents, $r_{pb}(56)=.0629$, $p<.001$, household income, r_{pb} (56)=.0805, $p<.0001$, health status, r_{pb} (56)=.1117, $p<.0001$, and health barriers, r_{pb} (56)=.0948, $p<.0001$. Measures with statistically significant differences, and moderate effect sizes, between retained and dropped cases were occupation and education. Retained cases were more likely to have had a white collar occupation (54.6%) than dropped cases (34.9%), $\chi^2(2, N=3273) = 80.40$, $p<.0001$, and more years of education (M=13.21, SE=.111) than dropped cases (M=12.02, SE=.215), r_{pb} (56)=.1740, $p<.0001$. There were 2,284 cases, 56 strata and 110 clusters in the final sample of retained cases.

Bivariate analyses were run on the retained cases. Where an association was found between Internet use and measures of social networking in the bivariate analysis, further examination was done with linear regression. The first set of regression models examined research question one which examines potential associations between Internet use and close ties. Regression models were built for the dependent variables number of close children, number of close other family, number of close friends, children confidants, other family confidants, friend confidants, contact with family, and contact with friends. Each model contained the independent variable of interest, Internet use, and controls for

race, gender, Hispanic status, marriage status, currently working status occupation of longest tenure, whether the respondent had children, age, number of household residents, annual income, years of education, health barriers, and health status. The Bonferroni method to control for Type-I errors adjusted the alpha level to .00625 (desired alpha level .05/number of models 8).

The next set of regression models examined research question two which examines attendance at organizations and in-person meetings with close ties. Regression models were built for the dependent variables in-person meetings with children, in-person meetings with other family, in-person meetings with friends, and attendance of organizations or clubs other than religious services. These models also included the Internet use measure and all of the control variables. The Bonferroni adjusted alpha level became .0125.

Models were examined to make sure the assumptions of regression modeling were met and diagnostics were performed to detect colinearity and outliers. Outliers are defined in this study as any case with a Cook's D value greater than one (Stevens, 1996). Using this criterion, there were no outliers and no colinearity was found.

During examination of the assumptions of regression a violation of the assumption of equal variance of errors was detected. To preserve the assumption of equal variance of errors, the control variable 'have children' was removed on models where the dependent variable regarded children.

The final regression tests looked for moderation of the association between Internet use and social networking measures by age. Only full models that were statistically significant and had a statistically significant Internet use parameter were

tested for moderation by age. An interaction term of Internet use by age was added to each full model that met the requirements and the statistical significance of the interaction term was examined. Because four models were tested, the Bonferroni method to control for Type I error adjusted the alpha level to .0125.

Results

Sample Demographics

The sample is described in detail in table 2. The cleaned dataset (*N*=2284) consisted of all cases with no missing data as described in the methods. Approximately half of the respondents were Internet users (49.8%). Most respondents were Caucasian (91.5%), married (72.7%), had children (87.5%), and slightly more than half were women (55.4%). Less than half worked at the time of the interviews (44.5%) and most had a white collar occupation (54.6%). The mean age was 63 with an average of two people living in a household and an average annual income of $62,000. The mean of the self-rated health of respondents was 3.28 and the mean score for health barriers was 2.14.

Respondents had contact with family (*M*=3.56, *SE*=0.02) about as frequently as with friends (*M* =3.76, *SE*=0.03). Respondents met in person most often with friends (*M*=4.16, *SE*=0.04), a bit less frequently with children (*M* =3.81, *SE*=0.06), and much less frequently with other family members (*M* =3.36, *SE*=0.04). They reported having more close friends (*M* =4.41, *SE*=0.11) than close other family members (*M* =3.70, *SE*=0.10) and twice as many close friends as close children (*M* =2.18, *SE*=0.06). However, when asked who they can open up to, children (*M* =2.93, *SE*=0.04) and friends (*M* =2.91, *SE*=0.03) were rated equally high, with other family (*M* =2.80, *SE*=0.03) rated a little lower. Respondents attended religious services about two or three times a month

(*M* =2.80, *SE*=0.04) and attended other meetings, clubs, or organizations they belong to about once a month (*M* =2.62, *SE*=0.05).

Table 2: Sample description (*N*=2284)

Categorical Variables		Interval Variables			
Variable	**%**	**Variable**	**Range**	***M***	***SE***
Internet use (yes)	49.80%	Age	51-101	63.27	0.45
Race		Household residents	1-4	2.14	0.03
(Caucasian)	91.50%	Income (in thousands)	0-187.5	62.16	2.17
(African American)	4.20%	Education	0-17	13.21	0.11
(Other)	4.30%	Health barriers	1-4	2.14	0.03
Gender (Female)	55.40%	Health status	1-5	3.28	0.04
Hispanic (Yes)	5.60%	Contacts w/family	1-6	3.56	0.02
Married (Yes)	72.70%	Contacts w/friends	1-6	3.76	0.03
Have children (Yes)	87.50%	In-person w/child	1-6	3.81	0.06
Working now (Yes)	44.50%	In-person w/other family	1-6	3.36	0.04
Occupation		In-person w/friends	1-6	4.16	0.04
(Blue Collar)	31.50%	Child confidant	1-4	2.93	0.04
(White collar)	54.60%	Other family confidant	1-4	2.8	0.03
(Unknown)	13.90%	Friend confidant	1-4	2.91	0.03
		Number close children	0-13	2.18	0.06
		Number close other family	0-12	3.7	0.1
		Number close friends	0-14	4.41	0.11
		Attend meetings	1-6	2.62	0.05
		Attend religious services	1-5	2.8	0.04

Bivariate Analysis Results

The bivariate results between the primary independent variable, Internet use, and all other variables are shown in table 3. There were no statistically significant differences between Internet users and non-users with respect to gender, $\chi^2(1,2282) = .07$, $p = .4285$. A significantly higher percentage of Internet users were Caucasian , $\chi^2(2, 2282) = 25.3$, $p < .001$, married, $\chi^2(1,2515) = 67.2$, $p < .0001$, working at the time of the interview, $\chi^2(1, 2282) = 190.2$, $p < .0001$, and had a white collar occupation as the occupation of longest tenure, $\chi^2 (2, 2282) = 205.2$, $p < .0001$, when compared to non-users of the Internet. A significantly lower percentage of Internet users were Hispanic $\chi^2(1, 2282) = 21.5$, $p < .0001$, and had children, $\chi^2(1, 2282) = 9.2$, $p < .05$, when compared to non-users of the

Internet. Internet users were younger, r_{pb} (55) =-.323, p<.0001, than non-users. Of those under 65 years of age, 62% were Internet users whereas only 33% of those 65 and over were Internet users, χ^2 (1, 2282) = 178.0, p < .0001. Internet users had more years of education, r_{pb} (55) =.399, p<.0001, a higher annual income, r_{pb} (55) =.358, p<.0001, and more household residents, r_{pb} (55) =.112, p<.0001, than non-users. Internet users rated their health status higher, r_{pb} (55) =.201, p<.0001, and had fewer health barriers, r_{pb} (55) =-.146, p<.0001 than non-users.

Internet use was significantly associated with all measures of social networking except attendance of religious services, r_{pb}(55) =.000, *ns,* and the number of close friends, r_{pb}(55) =-.039, p=.0624. Internet users have more contacts of all kinds with family, r_{pb}(55) 089, p<.0001, and friends, r_{pb}(55) =.237, p<.0001. Internet users reported more in-person contact with friends, r_{pb}(55) =.052, p<.001, but fewer in-person contact with close children, r_{pb}(55) =-.076, p<.001, and close other family, r_{pb}(55) =-.117, p<.0001, than non-users. Internet users felt they could open up more to friends, r_{pb}(55) =.051, p<.05, but could not open up as much to children, r_{pb}(55) =-.061, p<.001, or other family members, r_{pb}(55) =-.042, p<.05, as non-users could. Internet users reported fewer close children, r_{pb}(55) =-.090, p<.0001, and close other family members, r_{pb}(55) =-.093, p<.0001, , than non-users of the Internet. Internet users reported attending more meetings, clubs, and organizations (not including religious services), r_{pb}(55) =.107, p<.0001, than non-users of the Internet. Appendix B contains details of the bivariate results between each of the variables used in this study.

Table 3: Comparison of Internet users and non-users

Cases	Internet Users 1136 (49.75%)		Non Users 1148 (50.25%)			
Variable	**%**		**%**		χ^2	***V***
Internet use (yes)	-		-		-	-
Race						
(Caucasian)	94.5%		88.6%		25.348**	0.100
(African American)	2.7%		5.8%			
(Other)	2.8		5.7%			
Gender (Female)	54.5%		56.2%		0.699	0.017
Hispanic (Yes)	3.3%		7.8%		21.463***	0.092
Married (Yes)	80.4%		65.1%		67.247***	0.163
Have children (Yes)	85.4%		89.6%		9.168*	0.060
Working now (Yes)	58.9%		30.3%		190.181***	0.275
Occupation						
(Blue Collar)	21.8%		41.0%		205.190***	0.286
(White collar)	69.5%		39.8%			
(Unknown)	8.6%		19.2%			
	M	***SE***	***M***	***SE***	r_{pb}	
Age	60.07	0.45	66.43	0.46	-0.323***	
Household residents	2.23	0.04	2.05	0.04	0.112***	
Income (in thousands)	80.55	2.69	43.95	1.88	0.358***	
Education	14.29	0.08	12.13	0.15	0.399***	
Health barriers	1.99	0.03	2.28	0.04	-0.146***	
Health status	3.51	0.04	3.05	0.05	0.201***	
Contacts w/family	3.66	0.04	3.47	0.04	0.089***	
Contacts w/friends	4.05	0.04	3.47	0.05	0.237***	
In-person w/child	3.68	0.08	3.95	0.07	-0.076**	
In-person w/other family	3.18	0.05	3.55	0.05	-0.117***	
In-person w/friends	4.24	0.05	4.08	0.06	0.052*	
Child confidant	2.85	0.05	3.00	0.04	-0.061**	
Other family confidant	2.75	0.04	2.85	0.04	-0.042*	
Friend confidant	2.97	0.04	2.86	0.04	0.051*	
Number close children	2.03	0.06	2.33	0.09	-0.090***	
Number close other family	3.41	0.09	3.99	0.15	-0.093***	
Number close friends	4.25	0.15	4.56	0.17	-0.039	
Attend meetings	2.81	0.07	2.44	0.05	0.107***	
Attend religious services	2.80	0.05	2.79	0.06	0.000	

SE=Standard error of the mean
* p<.05, **p<.001, ***p<.0001

Regression Results

The first regression models were built to answer research question one which asked if Internet uses report fewer close social ties, confidants, or contacts with close ties than do non-users of the Internet. A Bonferroni adjusted alpha level of .0071 was used to determine statistical significance for these models. The models for the social networking dependent variables of "number of close children", "number of close other family", "children confidants", "other family confidants", and "friend confidants" were all statistically significant, but the independent variable of primary interest, Internet use, was not statistically significant, as shown in table 4. For these models, the bivariate association between Internet use and the measures of social networking did not hold when considering the control variables.

Table 4: Regression models for research question one: Internet use associations with social networking measures

Models (strata=56, strata collapsed=2, clusters=110)			Internet Use Parameter			
Dependent Variable	**Model *F****	**Adj. R^2**	***b***	***SE***	***t***	***Pr>|t|***
Number close children †	(15, 55) = 26.19	0.1340	-0.0202	0.0799	-0.25	0.8009
Number close other family	(16, 55) = 11.88	0.0450	-0.2808	0.1710	-1.64	0.1063
Children confidants †	(15, 55) = 19.84	0.1095	-0.0552	0.0596	-0.93	0.3585
Other family confidants	(16, 55) = 11.34	0.0263	-0.0623	0.0562	-1.11	0.2730
Friend confidants	(16, 55) = 11.07	0.0728	0.0135	0.0618	0.22	0.8282
Contact w/family †	(15, 55) = 18.71	0.0943	0.2344	0.0592	3.96	0.0002
- Reduced Model	(14, 55) = 15.77	0.0854				
- R2 Difference	(1,2268) = 22.14	0.0089				
Contacts w/friends	(16, 55) = 16.83	0.1369	0.5285	0.0638	8.28	<.0001
- Reduced Model	(15, 55) = 12.01	0.1034				
- R2 Difference	(1,2267) = 87.99	0.0335				

Note: Models include Internet use and controls for race, gender, Hispanic status, marriage status, currently working status occupation, whether the respondent has children, age, number of household residents, annual income, years of education, health barriers, health status, except were noted. The Bonferroni adjusted alpha level was .0071.
† = Variable 'have-children' was not included in these models.
* = p<.0001

However, the model for contacts with family, adjusted $R^2 = 0.09427$, $F(15,55) = 18.71$, $p < .0001$, and the Internet use variable in the model, $t = 3.96$, $p = 0.0002$, were both statistically significant. An R^2 difference test revealed that Internet use accounted for a statistically significant and unique amount of the variation in the contacts with family measure, $R^2 = 0.0089$, $F(1,2268) = 22.14$, $p < .0001$. Other parameters that accounted for a statistically significant amount of variation in the contacts with family measure were gender, $b = .4755$, $p < .0001$, age, $b = .0127$, $p < .00625$, and the number of household residents, $b = .1481$, $p < .00625$. All the parameters for the model are shown in table 5.

Table 5: Regression model parameters for research question one where Internet use is significant

	Contacts w/Friends Model Model $F(16, 55) = 16.83$ ** Adj. $R^2 = 0.1369$			**Contacts w/Family Model** † Model $F(15, 55) = 18.71$ ** Adj. $R^2 = 0.0943$		
Parameter	Estimate	*SE*	*t*	Estimate	*SE*	*t*
Intercept	2.0981	0.4577	4.584**	2.0328	0.3465	5.866**
Internet Use	0.5285	0.0638	8.283**	0.2344	0.0592	3.961*
Race African Am.	-0.1020	0.1869	-0.546	-0.1670	0.1257	-1.328
Race Other	-0.1065	0.2238	-0.476	-0.0448	0.1316	-0.340
Gender	0.4811	0.0626	7.687**	0.4755	0.0589	8.076**
Hispanic	-0.2250	0.1605	-1.402	-0.0516	0.1151	-0.449
Married	-0.1184	0.0775	-1.528	0.1495	0.0703	2.125
Working Now	-0.1691	0.0832	-2.032	-0.0416	0.0659	-0.631
Occupation Blue Collar	0.0039	0.0807	0.049	0.0575	0.0566	1.017
Occupation Other	-0.0940	0.0857	-1.096	0.0107	0.0624	0.171
Have Children	-0.1052	0.1166	-0.903	-	-	-
Age	0.0129	0.0042	3.053*	0.0127	0.0032	3.932*
Household Residents	-0.0624	0.0495	-1.259	0.1481	0.0426	3.477*
Household Income	0.0021	0.0007	3.025*	0.0011	0.0007	1.540
Education	0.0364	0.0171	2.121	-0.0271	0.0121	-2.242
Health Barriers	-0.0366	0.0327	-1.117	0.0045	0.0345	0.132
Health Status	0.0617	0.0301	2.051	0.0631	0.0311	2.032

Note: Models include Internet use and controls for race, gender, Hispanic status, marriage status, currently working status occupation, whether the respondent has children, age, number of household residents, annual income, years of education, health barriers, health status, except where noted. Bonferroni adjusted alpha was .0071.
† = Variable 'have-children' was not included in these models.
* p<.0071
** p<.0001

The model for contacts with friends, adjusted $R^2 = 0.1369$, $F(16,55) = 16.83$, $p < .0001$ and the Internet use variable in the model, $t = 8.28$, $p < .0001$, were also both statistically significant. An R^2 difference test revealed that Internet use accounted for a statistically significant and unique amount of the variation in the contacts with friends measure, $R^2 = 0.0335$, $F(1, 2267) = 87.99$, $p < .0001$. Other parameters that accounted for a statistically significant amount of variation in the contacts with friends measure were gender, $b = .4811$, $p < .0001$, age, $b = .0129$, $p < .00625$, and household income, $b = .0021$, $p < .00625$. All the parameters for the model are shown in table 5. For the contacts with friends and contact with family measures of social networking, the association with Internet use did hold even when considering the control variables.

The next regression models were built to answer research question two which asked if Internet users report less participation in organizations, attend religious services less often, or have fewer meetings with close ties than non-users of the Internet. A Bonferroni adjusted alpha level of .0125 was used to determine statistical significance for these tests. The models for the social networking measures of in-person meetings with close children and in-person meetings with close friends were significant, but the independent variable of primary interest, Internet use, was not statistically significant, as shown in table 6. For those models, the bivariate association between Internet use and the measures of social networking did not hold when considering the control variables.

Table 6: Regression models for research question two: Internet use associations with social networking measures

Models (strata=56, strata collapsed=2, clusters=110)			Internet Use Parameter			
Dependent Variable	**Model *F***	**Adj. R^2**	***b***	***SE***	***t***	***Pr>|t|***
In-person meetings w/children †	(15, 55) = 10.27 **	0.0624	-0.2294	0.0986	-2.33	0.0237
In-person meetings w/friends	(16, 55) = 8.74 **	0.0553	0.0575	0.0708	0.81	0.4202
In-person meetings w/other family	(16, 55) = 7.61 **	0.0407	-0.3025	0.0889	-3.40	0.0013
- Reduced Model	(15, 55) = 5.98 **	0.0342				
- R2 Difference	(1, 2267) = 15.22 **	0.0064				
Attend meetings	(16, 55) = 13.02 **	0.0846	0.2704	0.0813	3.33	0.0016
- Reduced Model	(15, 55) = 12.75 **	0.0802				
- R2 Difference	(1, 2267) = 10.95 *	0.0044				

Note: Models include Internet use and controls for race, gender, Hispanic status, marriage status, currently working status occupation, whether the respondent has children, age, number of household residents, annual income, years of education, health barriers, health status, except were noted. The Bonferroni adjusted alpha level is .0125.
† = Variable 'have-children' was not included in these models.
* p<.001
** p<.0001

The model for in-person meetings with close other family, adjusted $R^2 = 0.0407$, $F(16,55) = 7.61$, $p < .0001$, and the Internet use variable in that model, $t = -3.4$, $p = .0013$, were both statistically significant. An R^2 difference test revealed that Internet use accounted for a statistically significant and unique amount of the variation in the in-person meetings with close other family measure, $R^2 = 0.0064$, $F(1, 2284) = 15.22$, $p < .0001$. Other parameters that accounted for a statistically significant amount of variation in the in-person meetings with close other family members measure were gender, $b = .3137$, $p < .0001$, having children, $b = .3753$, $p < .0125$, and education, $b = -.0466$, $p < .0125$. All the parameters for the model are shown in table 7.

Table 7: Regression model parameters for research question two where Internet use is significant

	In-person w/Other Family Model Model $F(16, 55) = 7.61$ ** Adj. $R^2 = 0.0407$			**Meeting Attendance Model** Model $F(16, 55) = 13.02$ ** Adj. $R^2 = 0.0846$		
Parameter	Estimate	*SE*	*t*	Estimate	*SE*	*t*
Intercept	3.8953	0.4110	9.477**	-0.4648	0.5569	-0.835
Internet Use	-0.3025	0.0889	-3.401*	0.2704	0.0813	3.326*
Race African Am.	-0.2363	0.1878	-1.258	0.7716	0.1900	4.061*
Race Other	-0.3655	0.1713	-2.134	0.1599	0.2304	0.694
Gender	0.3137	0.0704	4.454**	0.1633	0.0993	1.645
Hispanic	-0.0932	0.1763	-0.528	0.2975	0.2072	1.436
Married	-0.0248	0.1096	-0.226	-0.0509	0.1266	-0.402
Working Now	0.0033	0.0892	0.037	-0.3306	0.0926	-3.571*
Occupation Blue Collar	0.1787	0.0737	2.423	-0.1261	0.0935	-1.349
Occupation Other	-0.1331	0.1272	-1.047	-0.1944	0.1240	-1.568
Have Children	0.3753	0.1210	3.102*	0.1641	0.1132	1.449
Age	-0.0066	0.0050	-1.326	0.0229	0.0049	4.647**
Household Residents	-0.0010	0.0628	-0.015	-0.0592	0.0566	-1.046
Household Income	0.0001	0.0011	-0.004	0.0023	0.0009	2.421
Education	-0.0466	0.0151	-3.086*	0.1028	0.0184	5.591**
Health Barriers	0.0128	0.0452	0.283	-0.0684	0.0401	-1.704
Health Status	0.0408	0.0407	1.003	0.0729	0.0454	1.606

Note: Models include Internet use and controls for race, gender, Hispanic status, marriage status, currently working status occupation, whether the respondent has children, age, number of household residents, annual income, years of education, health barriers, health status, except where noted. Bonferroni adjusted Alpha was .0125
* p<.0125
** p<.0001

The model for attend meetings and organizations other than religious services, adjusted $R^2 = 0.0846$, $F(16,55) = 13.02$, $p < .0001$, and the Internet use variable in that model, t=3.33, p =.0016, were also both statistically significant. An R^2 difference test showed that Internet use accounted for a statistically significant and unique amount of the variation in the attend meetings measure, $R^2 = .0044$, $F(1, 2284) = 10.95$, $p < .001$. Other parameters that accounted for a statistically significant amount of variation in the attend meetings measure were race African American, $b = .7716$, $p < .0125$, working now, $b = -0.3306$, $p < .0125$, age, $b = .0229$, $p < .0001$, and education, $b = .1028$, $p < .0001$. All the parameters for the model are shown in table 7. For in-person meetings with close other

family members and attend meetings, the association with Internet use did hold even when considering the control variables.

The last set of regression models were built to answer research question three which asked if age moderates any association Internet use has on measures of social networks. Four models were built, one for each measure of social networking that was associated with Internet use in the full regression models. As shown in table 8, with a Bonferroni adjusted alpha of .0125, none of the interaction terms were statistically significant. Age does not moderate any of the associations found between Internet use and measures of social networking while considering the control variables in this sample.

The hypothesis that there is no difference between Internet users and non-users with regard to their quality of social ties is not supported based on the finding that Internet users have more frequent contact with friends and family than non-users. The hypothesis that there is no difference between Internet users and non-users with regard to the frequency of in-person social contact for adults 51 years and older in the U.S. is also not supported by these data. Internet users have fewer in-person contacts with close family members not including children and they participate more in clubs and organizational meetings, excluding religious services. The hypothesis that there is no difference in the association between Internet use and social networks based on age for adults 51 years and older in the U.S. is supported by the results of this study as no tests for moderation were statistically significant.

Table 8: Tests for interaction between age and Internet use

Model (strata=56, strata collapsed=2, clusters=110)				**Interaction Term**			
Dependent Variable	*F*	*p*	R^2	*b*	*SE*	*t*	*p*
Contact w/family †	(16, 55) = 19.29	<.0001	0.0942	0.0043	0.0064	0.67	0.5077
Contacts w/friends	(17, 55) = 118.51	<.0001	0.1366	-0.0019	0.0071	-0.27	0.7897
In-person w/other family	(17, 55) = 17.21	<.0001	0.0402	-0.0014	0.0075	-0.19	0.8488
In-person w/friends	(17, 55) = 19.47	<.0001	0.0550	0.0027	0.0092	0.30	0.7674

Note: Models include Internet use and controls for race, gender, Hispanic status, marriage status, currently working status occupation, whether the respondent has children, age, number of household residents, annual income, years of education, health barriers, health status, except were noted. The Bonferroni adjusted alpha level is .0125.
† = Variable 'have-children' was not included in these models.

Discussion

Conclusions

This study investigates the potential for the Internet to be used as a tool to strengthen the social networks of older adults by examining the association between Internet use and social networks for middle aged and older. Part of the investigation utilizes Bonferroni adjustments to reduce the possibility of a type I error. Using the Bonferroni adjustment also increases the chance of a type II error being committed. This could affect some of the results in this thesis by not finding significance where tests actually are significant. However, this study examines three null hypotheses, and each hypothesis is tested with many regression models, and since only one of the tests need be significant to reject a null hypothesis, using a conservative approach to control for type I error is appropriate.

Internet users in this study were similar to those of other studies on Internet use, with Internet users tending to be younger, have more years of education, and a higher household income than non-users of the Internet. In this study, current employment and white collar occupations were also associated with Internet use. All of these factors support the idea that Internet use is associated with higher SES. Despite a broadening of Internet use (Katz & Aspden, 1997), the results of this study show evidence of a digital divide. These results suggest that cost and availability of the Internet may be a factor in any program that considers using the Internet as a tool.

The first null hypothesis examined states that for U.S. adults 51 years and older, there is no difference between Internet users and non-users with regard to their quality social ties. One theory that looks at Internet use and social networks contends that Internet use replaces high quality face-to-face ties with weaker online ties (Coget et al., 2002; Kraut et al., 1998). Whereas this study found no differences in the number of close relationships or confidants between Internet users and non-users, a statistically significant difference in frequency of contacts with friends and family was found even when considering the control variables used in this study. This study rejects the first null hypothesis in favor of the alternative that for U.S. adults 51 years of age and older, the quality of social ties for internet users differ from that of non-users of the Internet. Berkman and Glass (2000) report that frequency of contact is one measure of the quality of social ties. This study shows a positive association between Internet use and frequency of contact with friends and family. Thus, the Internet may be a tool which could be used to strengthen this measure of the quality of social ties.

The second null hypothesis examined is that for U.S. adults 51 years and older, there is no difference between Internet users and non-users with regard to frequency of in-person social contact. Two of the five measures of in-person social contact were found to be statistically significantly different for Internet users and non-users. Internet users met in-person fewer times with close other family members than did Internet non-users. It is not clear, however, if this finding supports the displacement theory (Kraut et al., 1998; Nie & Hillygus, 2002), or if respondents meet less often with this group because of other factors such as lack of mobility or physical distance. Internet users are more likely to participate in organizations or clubs (excluding religious services) than

Internet non-users. This finding is consistent with other studies that suggest the Internet is a positive influence on community involvement (Bargh & McKenna, 2004). Though Internet users in this sample were more healthy and younger than Internet non-users, those factors were considered in the regression model suggesting Internet use increases community participation even when those factors are considered. This study rejects the second null hypothesis in favor of the alternative that, for U.S. adults 51 years and older, there are differences between Internet users and non-users with regard to frequency of in-person social contact. The difference suggests a positive impact on community involvement, but is inconclusive on in-person family contacts.

The hypothesis that there is no difference in the association between Internet use and social networks based on age for adults 51 years and older in the U.S. is supported by the results of this study, as no tests for moderation were statistically significant. Though older adults do have more discretionary time than younger adults (Moss & Lawton, 1982), it does not appear to impact any association between Internet use and social networks.

Results of this thesis support the idea that Internet use may improve frequency of contact with family and friends. Results also show a positive association between Internet use and in-person community involvement for middle-aged and older adults in the United States. With the findings from the literature review that social networks play an important part in human well being, it is important to utilize available tools to counter the weakening of social networks that face older adults. As the Internet evolves, it is becoming more capable of supporting human social interactivity, as shown by the growth of web sites dedicated to social interaction. This study finds that the Internet could be used as a tool to strengthen social networks of older adults.

Limitations

This study uses a cross-sectional design, and as such, cannot determine if differences in characteristics of social networks are determined by Internet use, or if the use of the Internet is caused by differences in characteristics of social networks. Internet use is a dichotomous measure in this study and therefore the amount of time spent on Internet use is not known. Nie and Hillygus (2002) suggest that possible effects of Internet use will be concealed if time spent on the Internet is not considered in analysis of Internet use. In addition, the use of the phrase "regular use of the World Wide Web" in the survey question is a subjective measure of internet use, so the reported use of the Internet may not be equal between respondents.

SAS 9.1 is not capable of adjusting the weights of cases based on the reduction of sample size (due to missing data). Weights were designed for the full 2004 wave of the Health and Retirement Survey. Though they were normalized according to size of the sample used in this study, the weights themselves were not adjusted. This fact may reduce the generalizability to the population from which the sample was taken.

There were many statistically significant differences between cases retained for this study and cases dropped due to missing data. The sample is large so it is not surprising to find statistical significance. Most of the differences have small effect sizes (V<=0.1, r <=0.1). However, significantly different measures with the largest effect sizes show retained cases were more likely to be Internet user, $\chi^2(1, N=3155) = 60.34$, $p<.0001$, $V= 0.1427$, be younger, r_{pb} (56)=.1178, $p<.0001$, have had a white collar occupation, $\chi^2(2, N=3273) = 80.40$, $p<.0001$, $V= 0.1693$, and have more years of education, r_{pb} (56)=.1740, $p<.0001$, than dropped cases. Thus, there is a possible bias towards respondents that are

younger and have a higher SES, indicating the findings may not be generalizable to the population of all middle-aged and older adults in the United States.

Implications for Health Education and Public Health

The positive association this study shows Internet use has with social networks can be useful to health educators and other public health authorities in planning social network interventions. Some strategies used in social network interventions include enhancing existing social network linkages and developing new social network linkages (Heaney & Israel, 2002). These strategies could make use of the Internet to facilitate strengthening of social networks. The Internet could be of special use where the selected population lacks mobility, or has close ties at a distance. In addition, this study suggests that Internet use by older adults will increase as the current middle-aged population ages, and that those entering retirement are more likely to have computer knowledge than those who retired previously. The more computer literate aging population will make Internet-based interventions more realizable and less expensive as training costs drop.

This study also suggests that changes to policies that affect availability of the Internet should be considered. There has been legislation to limit taxes on the Internet as an incentive for commercial transactions (Kraut et al., 1998). It may be possible to create similar policies that would foster social networking via the Internet or increase the availability of the Internet. Such policies should be considered to reduce the digital divide which result suggest exist between those with low SES and those with a higher SES.

The Internet could also be tapped by communities to increase community involvement. The findings of this study that Internet use is associated with higher levels

of participation in meetings (other than religious services) suggests that communities' interventions may include Internet tools without the fear that Internet use will diminish in-person participation.

Future Directions

The results of this study, along with other studies reported in the literature, suggest a need for a detailed study of the didactic ties that make up social networks and the effect Internet use has on those ties. Such a study would help in understanding how ties based on the Internet fair to off-line ties and the spectrum between. Only through this kind of study can one start to understand the impact Internet use has on the strength of ties. More encompassing details of personality also need to be included in such studies, including level of extroversion for example. With the use of the Internet growing, it is critical that one understand its impact on society.

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Appendices

Appendix A: Data Descriptions

The following is a description of all modifications made to variables in this study. The first line describes the variable, the second line gives the original variable name and dataset. Datasets are noted as follows: PLB is the Psychosocial Leave-Behind dataset; HRS Core is the 2004 Core dataset; Tracker is the 2004 Tracker file released in January 2007; RAND is the 2004 RAND HRS dataset version F. If the variable is renamed, the new name follows the original name/dataset. If there is any additional information about the variable or details of changes made, they are listed on a third line.

Miscellaneous Variables

Have any immediate family (example, any brothers or sisters, parents, cousins or grandchildren)
- JLB514 PLB

Have any friends
- JLB518 PLB

Have any children
- JLB510 PLB have_chd
- If missing and h7child=0 then =no; if missing and h7child>0 then =yes (change 5 to 0).

Number of living children
- H7CHILD PLB

Meet up with children
- JLB512A PLB mt_child
- If no children (jlb510) and is missing data, set to 6 (never), reverse code.

Speak on phone with children
- JLB512B PLB ph_child
- If no children (jlb510) and is missing data, set to 6 (never), reverse code.

Write or Email children
- JLB512C PLB wr_child
- If no children (jlb510) and is missing data, set to 6 (never), reverse code.

Meet up with other family members
- JLB516A PLB mt_ofm
- If no other family members(jlb514) and is missing data, set to 6 (never), reverse code.

Appendix A: (Continued)

Speak on phone with other family members
- JLB516B PLB ph_ofm
- If no other family members(jlb514) and is missing data, set to 6 (never), reverse code.

Write or Email other family members
- JLB516C PLB wr_ofm
- If no other family members(jlb514) and is missing data, set to 6 (never), reverse code.

Meet up with friends
- JLB520A PLB mt_frd
- If no friends (jlb514) and is missing data, set to 6 (never), reverse code.

Speak on phone with friends
- JLB520B PLB ph_frd
- If no friends (jlb514) and is missing data, set to 6 (never), reverse code.

Write or Email friends
- JLB520C PLB wr_frd
- If no friends (jlb514) and is missing data, set to 6 (never), reverse code.

Open up to Spouse
- JLB508C PLB open_sp
- If no spouse(jcouple=5) and is missing data, set to 4 (not at all), reverse code.

Open up to children about worries
- JLB511C PLB open_chd
- If no children (jlb510) and is missing data, set to 4 (not at all)., reverse code.

Open up to other family about worries
- JLB515C PLB open_ofm
- If no other family members(jlb514) and is missing data, set to 4 (not at all).

Open up to friends about worries
- JLB519C PLB open_frd
- If no friends (jlb514) and is missing data, set to 4 (not at all)., reverse Code.

Number of children in close relationship
- JLB513 PLB num_chd
- If no children (jlb510) and is missing data, set to zero.

Number of other family in close relationship
- JLB517 PLB num_ofm
- If no other family members(jlb514) and is missing data, set to zero.

Number of friends in close relationship
- JLB521 PLB num_frd
- If no friends (jlb514) and is missing data, set to zero

Left Behind Survey Type
- JLBTYPE PLB
- (1=financial, 2=psycosocial, 3=both)

Appendix A: (Continued)

Weight -
- JWGTR Tracker rel_wgt
- Raw weight used to account for oversampling (divide by mean wgt of sample to get relative weight).

SECU -
- SECU Tracker
- Used to account for complex sample design (SAS Cluster variable).

Strata -
- STRATUM Tracker
- Used to account for complex sample design (SAS Strata variable).

Number of missing variables
- num_miss
- Calculated by checking for missing data on all variables to be used in bivariate and regression analyses.

Dependent Variables

Contacts with Friends
- con_friend
- Mean(mt_frd, ph_frd, wr_frd).

Contacts with Family
- con_family
- Mean (mt_child, ph_child, wr_child, mt_ofm, ph_ofm, wr_ofm).

In-person meetings with friends
- mt_frnd ipm_friend

In-person meetings with children
- mt_child ipm_child

In-person meetings with other family members
- mt_ofm ipm_ofm

Child confidant
- open_chd cfd_child

Other family confidant
- open_ofm cfd_ofm

Friend Confidant
- open_frd cfd_friend

Number of close Family
- num_chd nc_child

Number of close other family
- nc_ofm
- num_ofm, if>12 then set to 12 (95th percentile)

Number of close friends
- nc_friend
- num_frd, if >14 then set to 14 (95th percentile)

Appendix A: (Continued)

Attend meetings or programs
- JLB502 PLB att_meet
- Reverse code.

Attend religious Services
- JB082 PLB att_rel
- Codes 8&9 = missing, reverse Code.

Independent & Control Variables

Internet Use
- JW303 HRS Core int_use
- Recode 5 to 0 (do not use Internet), 1= use Internet, over 5=missing.

Race of respondent
- RACE Tracker race2
- 1=W(1), 2=AA(2), 3=OTH(7), missing (0,.)

African American dummy code
- race2 race_aa
- African American/ white as reference (dummy code).

Other race dummy code
- race2 race_oth
- Other / white as reference (dummy code).

Age at start of 2004 interview
- JAGE Tracker

Education in years
- SCHLYRS Tracker schooly
- Recode over 17 missing (97=other).

Hispanic
- HISPANIC Tracker hisp2
- From Mexican American, Other Hispanic, Not Hispanic, to Yes/No.

Gender or respondent at time of interview
- GENDER Tracker
- Change from 1,2(female) to 0,1(female).

Married or Partnered
- JCOUPLE Tracker married
- Recode 5=0.

Health stops me from doing things
- JLB503H PLB hlth_bar
- Reverse code.

Self Reported Heatlh Status
- JC001 HRS Core health
- recode over 5 is missing (8&9=missing codes). Reverse Code.

Household Residents
- H7HHRESRAND hh_residents
- If >4 set to 4 (95th percentile).

Appendix A: (Continued)

Job Status
- JJ005M1 HRS Core work_now
- If =1 set to 1(Working); else if 2-7 set to 0 (Not working); else set to missing.

Longest Job Occupation Code
- R7JLOCC RAND occ_code
- [1-4]=1 (white collar), [5-16]=0 (blue collar), [17-military, or missing]=2 (unknown).

Blue collar dummy code
- occ_code occ_blue
- Blue collar, white collar as reference (dummy code).

Unknown occupation dummy code
- occ_code occ_other
- Unknown occupation with white collar as reference (dummy code).

Total household income (respondent & Spouse)
- H7ITOT RAND hh_income
- If > 187500 then it is set to 187500 (95th percentile). Divide by 1000.

Appendix B: Tables of Association

Table B-1: Chi-square, P-value, and Cramer's V for categorical variables

		1	2	3	4	5	6	7
1.Internet Use								
2.Race	χ^2	25.35						
	$p>\chi^2$	0.0002						
	V	0.1004						
3.Gender	χ^2	0.70	0.82					
	$p>\chi^2$	0.4285	0.6466					
	V	0.0167	0.0180					
4.Hispanic	χ^2	21.46	439.49	1.39				
	$p>\chi^2$	0.0001	0.0000	0.2761				
	V	0.0923	0.4179	0.0235				
5.Married	χ^2	67.25	57.69	60.80	0.37			
	$p>\chi^2$	0.0000	0.0000	0.0000	0.5103			
	V	0.1635	0.1514	0.1554	0.0121			
6.Working Now	χ^2	190.18	0.13	19.08	0.71	23.97		
	$p>\chi^2$	0.0000	0.9338	0.0001	0.5126	0.0000		
	V	0.2749	0.0071	0.0871	0.0168	0.0976		
7.Occupation	χ^2	205.19	19.28	62.81	10.47	23.27	170.66	
	$p>\chi^2$	0.0000	0.0062	0.0000	0.0025	0.0003	0.0000	
	V	0.2855	0.06188	0.1580	0.0645	0.0962	0.2604	
8.Have Children	χ^2	9.17	1.57	4.43	0.01	85.17	19.92	2.94
	$p>\chi^2$	0.0257	0.6499	0.1040	0.9449	0.0000	0.0008	0.4018
	V	0.0604	0.0250	0.0420	0.0017	0.1839	0.0890	0.0342

Note: A p-value of zero indicates p<.0001.

Appendix B: (Continued)

Table B-2: Correlation matrix

	1	2	3	4	5	6	7	8	9	10
1. Age	1									
2. HH Residents	-0.2587	1								
3. HH Income	-0.2590	0.1928	1							
4. Education	-0.1744	0.0000	0.4140	1						
5. Health Barriers	0.1739	-0.0378	-0.2515	-0.1713	1					
6. Health Status	-0.0708	0.0246	0.3288	0.3103	-0.5719	1				
7. Contacts w/Family	0.0559	0.1191	0.0656	-0.0263	-0.0178	0.0839	1			
8. Contacts w/Friends	0.0344	-0.0749	0.1345	0.1817	-0.0843	0.1510	0.3467	1		
9. In-person w/Children	0.0834	0.1177	0.0443	-0.0960	0.0000	0.0253	0.7056	0.1002	1	
10. In-person w/Other Family	0.0000	0.0000	-0.0577	-0.1319	0.0000	0.0000	0.6213	0.1698	0.3563	1
11. In-person w/Friends	0.0636	-0.0891	0.1058	0.1133	-0.0790	0.1122	0.2293	0.8023	0.1495	0.2281
12. Children Confidants	0.1906	0.1336	0.0000	-0.0754	-0.0361	0.0794	0.5111	0.1098	0.5322	0.1645
13. Other Family Confidants	0.0073	0.0000	-0.0515	-0.0425	-0.0327	0.0589	0.3527	0.1751	0.1335	0.3437
14. Friend Confidants	0.0000	-0.0884	0.0289	0.1039	-0.0579	0.1209	0.1493	0.5241	0.0399	0.1040
15. Number Close Children	0.1942	0.2202	-0.0293	-0.1417	0.0000	0.0000	0.3821	0.0000	0.4480	0.1392
16. Number Close Other Family	0.1158	0.0609	-0.0355	-0.1094	0.0000	0.0000	0.3217	0.1127	0.1895	0.3426
17. Number Close Friends	0.1674	0.0688	0.0000	0.0550	-0.0490	0.0774	0.1144	0.3886	0.0491	0.0870
18. Attend Meetings	0.0948	-0.0432	0.1070	0.1927	-0.0757	0.1229	0.1592	0.3130	0.0420	0.0676
19. Attend Religious Services	0.1218	-0.0261	0.0000	0.0776	-0.0493	0.1340	0.1999	0.1711	0.1355	0.1070
20. Internet Use +	-0.3225	0.1121	0.3581	0.3986	-0.1458	0.2013	0.0889	0.2367	-0.0759	-0.1167
21. Race †	0.1121	0.0666	0.1052	0.0940	0.0301	0.1367	0.0558	0.0876	0.0269	0.0243
22. Gender +	0.0277	-0.0678	-0.1000	-0.1007	0.0346	0.0000	0.2095	0.1885	0.0895	0.1004
23. Hispanic +	-0.0986	0.1106	-0.1084	-0.1931	0.0133	-0.1017	0.0000	-0.1078	0.0000	0.0000
24. Married +	-0.1215	0.4659	0.3607	0.0497	-0.0797	0.1309	0.1111	-0.0230	0.1343	0.0000
25. Working Now +	-0.5241	0.1537	0.3769	0.2584	-0.2530	0.2372	-0.0221	0.0000	-0.0347	-0.0246
26. Occupation †	0.3686	0.1144	0.3102	0.4366	0.1745	0.2320	0.0351	0.1562	0.0505	0.0888
27. Have Children +	0.1362	0.1965	0.0000	-0.1209	0.0000	0.0000	0.5072	-0.0304	0.6064	0.0925

Values are Spearman rank correlations except where marked. † = Eta values. + = Point-biserial
All correlations can be interpreted as Pierson Product Moment correlations.
Critical Values for 2284 cases: at r=.0410 α=.05, at r=.0539 α=.01, at r=.069 α=.001, at r=.0795 α=.0001.
For categorical to categorical associations, see table B-1.

Appendix B: (Continued)

Table B-2. Correlation Matrix (Continued)

	11	12	13	14	15	16	17	18	19
1. Age									
2. HH Residents									
3. HH Income									
4. Education									
5. Health Barriers									
6. Health Status									
7. Contacts w/Family									
8. Contacts w/Friends									
9. In-person w/Children									
10. In-person w/Other Family									
11. In-person w/Friends	1								
12. Children Confidants	0.1049	1							
13. Other Family Confidants	0.1327	0.2812	1						
14. Friend Confidants	0.4330	0.2034	0.2900	1					
15. Number Close Children	0.0172	0.5073	0.1079	0.0000	1				
16. Number Close Other Family	0.1089	0.2373	0.3570	0.1107	0.3133	1			
17. Number Close Friends	0.3706	0.1478	0.1862	0.3293	0.0805	0.3124	1		
18. Attend Meetings	0.2655	0.0649	0.0931	0.1183	0.0386	0.0738	0.1843	1	
19. Attend Religious Srvs	0.1487	0.1429	0.1445	0.1221	0.1238	0.1473	0.2100	0.2892	1
20. Internet Use	0.0522	-0.0609	-0.0422	0.0507	-0.0898	-0.0925	-0.0392	0.1073	0.0000
21. Race †	0.0991	0.0383	0.0000	0.0605	0.0164	0.0619	0.0604	0.0466	0.0692
22. Gender +	0.0697	0.1382	0.1323	0.2095	0.0509	0.0577	0.0000	0.0433	0.0841
23. Hispanic +	-0.1102	0.0000	0.0457	-0.0598	0.0000	0.0000	-0.0301	-0.0111	0.0084
24. Married +	-0.0159	0.1255	-0.0217	-0.0553	0.1094	0.0560	0.0218	0.0000	0.0340
25. Working Now +	-0.0249	-0.0941	-0.0170	0.0000	-0.1034	-0.0978	-0.0868	-0.0535	-0.0706
26. Occupation †	0.0605	0.0553	0.0000	0.0887	0.0997	0.0309	0.0529	0.1457	0.0865
27. Have Children +	0.0000	0.6505	0.0427	-0.0154	0.5009	0.0941	0.0000	0.0158	0.1011

Values are Spearman rank correlations except where marked. † = Eta values. + = Point-Biserial
All correlations can be interpreted as Pierson Produce Moment correlations.
Critical Values for 2284 cases: at r=.0410 α=.05, at r=.0539 α=.01, at r=.069 α=.001, at r=.0795 α=.0001.
For categorical to categorical associations, see table B-1.