Religious Activity and Mortality in the Elderly: The Cache County Study

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RELIGIOUS ACTIVITY AND MORTALITY IN THE ELDERLY:
THE CACHE COUNTY STUDY

by

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ABSTRACT

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No study, to date, has systematically examined the interplay of social contact, depression, functional disability, and cardiovascular health when examining the relation between religious activity and all-cause mortality. This study used Cox regression models as well as a series of structural equation models to elucidate these relations and resultant mortality over a 5-year period. This sample included 3,607 persons, age 65 and older, who participated in the Cache County Study on Memory in Aging, and who were not demented. Results indicate that when using Cox regression modeling, after controlling for other variables related to mortality, both religious activity and social contact remained statistically significant predictors of survival time. Based on hazard ratios obtained from the Cox regression models, it was found that subjects who attend church activities at least once a week or more are 41.6% less likely to die than subjects who attend church less frequently. Subjects who increase their social contact by each additional level gain 3% protection against mortality. Surprisingly, depression was not
related to mortality in any analyses. Therefore, the best-fitting structural equation model did not include depression. Possibly, the most interesting findings from this study were the mediating effects found between functional disability, religious activity, social contact, and all-cause mortality. Using a nested series of structural equation models, we found that social contact mediates the relation between functional disability and mortality and that religious activity mediates the relation between functional disability and social contact. These results indicate that social contact may be a crucial underlying mechanism, which is triggered by religious activity, and therefore acts as a mediator between functional disability and mortality. Limitations of this study include narrow or unidimensional measures, as well as problems with reliability. Due to the homogeneity of this sample, it may be very difficult to justify generalizing these results to a different population. Despite these limitations, this study finds that both religious activity and social contact converge in their effects on mortality and their interconnectedness is evident from these results. Both religious activity and social contact have important implications for the health of our elderly. Nevertheless, many multilayered aspects of religious behavior and social networks have not been addressed in this study. Future work investigating the consequences of the longitudinal aspects of religious belief, social networking, and depression is needed.

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CHAPTER I
PROBLEM STATEMENT

The examination of religious activity and its relation to health is an ongoing endeavor (Kark et al., 1996; Koenig, George, Hays, & Larson, 1998). Evidence is growing that religious activity is related to less depression (Koenig et al., 1992), less functional disability (Idler & Kasl, 1992), better immune function (Koenig et al., 1997), and less risk for mortality (Koenig et al., 1999; Ringdal, 1996). One reason why religious activity is related to better health may be found in the social networks that are integral to religious communities. Social contact has been theorized to be the underlying mechanism that is triggered by religious activity. People who are regularly in contact with a supportive social group may tend either to self-regulate their own health better or may be monitored more closely by their social group. If religious activity is engaging the social contact system, then it may be true that "...the association of religious involvement and physical health might be more closely tied to the psychosocial resources that religious activity provides rather than any positive psychological states engendered specifically by more private forms of religious expression" (McCullough, Hoyt, Larson, Koenig, & Thoresen, 2000, p. 211). Therefore, measures of group religious activities may be more strongly associated with physical health outcomes than measures of personal religious belief.

Public religious activity is obviously tied to the physical ability to attend religious services. When studying a sample of elderly persons, cardiovascular health and functional disability must be considered salient variables in the frequency of religious activity. It is
most likely that persons who are more functionally able will be attending religious services more frequently. Not surprisingly, functional disability has been found to be correlated with overall health (Branch, 1985; LaCroix, Guralnik, Berkman, Wallace, & Satterfield, 1993) and therefore may confound any relations found between religious activity and health. Clearly, religious activity in relation to any health outcome should not be examined in isolation.

Another potentially confounding variable shown to be related to religious activity as well as to physical health and mortality is depression. Depression has been found to be related to the reduction of immune function (Irwin et al., 1990; Leserman et al., 1997), which would obviously have an impact on overall health and potentially death. But the relation between depression and mortality is more ambiguous. Zuckerman, Kasl, and Ostfeld (1984) found that in a sample of 400 elderly poor, depression was related to increased mortality rates. However, Devins et al. (1990) found that for patients in end-stage renal disease, depression did not decrease survival rates, although this may have been due to the seriousness of the disease.

Depression is a factor that may be related to social contact as well as to functional disability. Depression may either result from lack of social contact or social contact may be reduced due to depressive symptoms. Similarly, depression could either be caused by the lack of functional ability or alternatively the lack of functional ability could be a symptom of depression. Research has shown the complicated intertwining of religious activity, depression, social contact, and functional disability and their varied influences on physical health and mortality (Bryant & Rakowski, 1992; Colantonio, Kasl, & Ostfeld,
1992; Idler & Kasl, 1991). Therefore, depression is a crucial psychosocial variable to examine in relation to religious activity and mortality.

The purpose of this study was to analyze the interrelations among social contact, depression, functional disability, religious activity, and resultant all-cause mortality over 5 years. The sample consisted of 3,607 persons, age 65 and older, who participated in the Cache County Study on Memory in Aging, and who were not demented. The research questions were: 1. Does religious activity account for a significant amount of the variance in survival time after statistically controlling for age, gender, cardiovascular health, social contact, depression, and functional disability? 2. Does depression account for a significant amount of the variance in survival time after statistically controlling for age, gender, cardiovascular health, social contact, functional disability, and religious activity? 3. Does social contact account for a significant amount of the variance in survival time after statistically controlling for age, gender, cardiovascular health, depression, functional disability, and religious activity? 4. Does gender moderate the effect of religious activity on survival time after statistically controlling for age, cardiovascular health, social contact, depression, and functional disability? 5. Does the path analysis model fit the data? 6. Does religious activity mediate the effect of functional disability on social contact, depression, or mortality? 7. Does social contact mediate the effect of religious activity on depression or mortality? 8. Does social contact mediate the effect of functional disability on depression or mortality? 9. Does depression mediate the effect of social contact or religious activity on mortality?
CHAPTER II
LITERATURE REVIEW

The psychology of religion is a field of study that has evolved over many years. One of the most important contributors to the early development of this area of study was Francis Galton. He was the first prominent scientist to attempt to systematically study the relation between religion and mortality. Galton (as cited in Wulff, 1997) studied the effects of other's prayers in behalf of reigning sovereigns, by comparing ages at death for male members of the royal house with other upper-class males. He concluded that regardless of other's prayers, male members of royalty died sooner than other upper-class members of society. He also studied exceptionally religious persons who were noted in books on religious notables, to determine whether leading an extremely pious life extended life. He again concluded that these "Divines" were less long-lived than other eminent men. Galton did find, however, that ordinary clergy had a slight advantage in longevity over other persons with professional occupations (Wulff, 1997).

Clearly, his methods of sampling only male members of royal houses or extraordinarily pious men (who happened to be mentioned in a book) introduce bias and throw doubt on his conclusions. It is notable that his least-biased comparison, that of the clergy versus other professional class groups, had a significant finding. He found that the clergy did have an advantage in longevity, although he explained this finding by attributing it to "the easy country life and family repose" (Wulff, 1997, p. 206).

As shown in the following literature review, the early finding that religious activity may be beneficial to one's health and longevity has been greatly expanded upon in recent
years. Due to increased rates of death as the population ages (Himes, Preston, & Condran, 1994), the most salient population in a study of mortality is an elderly population that has a higher mortality rate compared to other age groups. The following review of the literature will examine factors that may be related to health and mortality in the elderly. Then a discussion will follow about how these factors are interrelated and may moderate or mediate the relation between religious activity and mortality.

Factors Related to Health in the Elderly

A variety of factors may influence the health and well-being of the elderly. Many older people must deal with declines in physical functioning, including a decline in mobility, as well as a reduction in social networks (mortality of friends and family), and depression. Studies have estimated the prevalence of significant depression in the elderly is between 15 and 20% (Gallo & Lebowitz, 1999) and have shown that there is an increasing incidence of depression with age (Pollock & Reynolds, 2000). It is likely that the higher risk of depression may be due to declines in physical functioning and the reduction in social networks, among other things (Oxman & Hull, 1997).

Physical functioning is often measured in the literature using activities of daily living (ADL) scales (Appollonio, Carabellese, Frattola, & Trabucchi, 1996; Avlund, Damsgaard, & Holstein, 1998; Colantonio et al., 1992). Regular physical activity is consistently found to promote health. Those who are more physically active have increased bone density, improved lipid profiles, increased strength, balance, and coordination, improved aerobic capacity, and decreased depression (Buchner & Wagner,
A strong relation is found between reduced function and higher mortality rates in the elderly (Appollonio et al., 1996). This can be due to reduced functional ability which leads to reduced activity levels thereby hastening a physical decline (LaCroix et al., 1993), or it could be that health problems reduce one’s ability to function independently. The direction of the relation is not clear at this time and is likely to be bidirectional. In contrast, the relation between physical disability and depression is well established (Rodin & Voshart, 1986). It has been hypothesized that physical disability from illness is the main path to depression in older adults (Williamson & Schulz, 1992).

Less frequent contact with one’s social network has been directly related to increased mortality (Avlund et al., 1998; Eriksson, Hessler, Sundh, & Steen, 1999; House, Robbins, & Metzner, 1982). In the House et al. (1982) study, patterns of social network use and mortality were different for men compared to women. Men who reported higher levels of social activity, after adjusting for age and various health variables, were likely to live longer than men who reported lower levels of social activity. Women showed similar trends, but none of the analyses were statistically significant after controlling for age and other risk factors. Avlund et al. (1998) also found different patterns for men and women. For men, poor functional ability, living alone, and not helping others (a form of social activity) were related to higher mortality rates. For women, poor functional ability and not receiving help from others with tasks other than ADL’s were related to higher mortality rates. Eriksson et al. (1999) combined longitudinal data from two studies, one in Missouri and one in Gothenburg, Sweden. Their findings were similar to the Avlund et al. study. The use of social networks was an important predictor of mortality, although
different patterns of social network use were found between the two cultures. Participation in formal social organizations and being married were predictive of lower mortality for Americans, while more frequent contact with their children was predictive of lower mortality for Swedes.

Both lower physical functioning and decreased contact with a social network have been shown to be related to depression, thereby directly influencing mortality as well as indirectly influencing mortality through depression. Not all studies that have examined social contact or physical functioning and their relation to mortality have been conducted using depression as a covariate. Therefore, the relations between these factors, depression and mortality, are not yet clear.

Depression has been shown to be detrimental to one’s health. For example, it has been related to reductions in immune function. Kronfol, Turner, Nasrallah, and Winokur (1984) found reduced lymphocyte stimulation by mitogens for medication-free, hospitalized depressives compared to controls. This decrease in lymphocyte response in depressed patients results in poor immune function. A similar reduction in natural killer cell activity for depressives was found by Irwin, Smith, and Gillin (1987) and was replicated by Irwin et al. in 1990, who found an alarming 50% reduction in natural killer cytotoxicity when major depression and stressful life events were jointly examined. Another prospective study found similar results when examining HIV-positive men longitudinally (Leserman et al., 1997). They found that participants who scored above the mean on measures of severe stress and depressive symptoms were the most likely to have declines in T cells as well as declines in natural killer cells. These findings illustrate the
toxic nature of depression on physical health and ultimately on mortality.

The literature shows the interrelatedness of depression and social contact, social contact and functional ability, and functional ability and depression. Because these variables have been shown to impact health, and religious activity has been shown to impact health, the next logical question is how religious activity interacts with depression, social contact, and functional ability to affect mortality.

The Benefits of Religious Activity

Religious activity may mitigate these factors through a variety of mechanisms. Regular religious service attendance usually indicates a stronger adherence to health and lifestyle restrictions (e.g., restrictions on alcohol, tobacco, drugs; Ellison, 1994; Enstrom, 1989). Regular religious service attendance also allows regular contact with a social network. This regular contact with a social network at church may provide a systematic means of monitoring physical and mental health, peer pressure to maintain physical and mental health, help with chores or home maintenance, and someone to turn to in times of stress or physical need.

Indeed, people who frequently attend religious services are more likely to be involved with a network of friends (and therefore participate in social activities) than those who do not attend services regularly (Jarvis & Northcott, 1987). Taylor and Chatters (1986) found that church members provide informal support for one another through prayer and friendship. Religious involvement may also provide methods of coping with stressful life events that may, in turn, be important for long-term health and mortality.
(Kark et al., 1996; Krause, 1998) In the Kark et al. (1996) study, 22 kibbutzim in Israel, 11 religious and 11 secular, were compared for mortality rates over a 16-year period. Even after measurements across social contact, socioeconomic status, and access to health care were controlled, membership in a secular versus a religious kibbutzim accounted for an odds ratio of 1.93 for overall mortality.

These results do not necessarily address the mechanisms that may account for better coping among the more religiously active. A study on religious activity and blood pressure may provide another piece to the puzzle (Koenig et al., 1998). Cross-sectional analyses found that for frequent church goers (once a week or more), after controlling for demographics and physical functioning, consistent differences were found in diastolic and systolic blood pressure levels when compared to infrequent church goers. When examining longitudinal data, it was also found that baseline religious activity predicted 3-year blood pressures. They also found that the likelihood of persons who were both regular attenders of religious services and prayed regularly or studied the Bible to have a high diastolic blood pressure was an amazing 40% lower than persons who did not regularly attend services as well as pray and study (Koenig et al., 1998). These findings indicate that religious activity may serve as an excellent coping mechanism for dealing with stressful life events, thus helping regulate bodily functions like blood pressure, although the nature of the "mechanism" continues to be elusive.

Hummer, Roger, Nam, and Ellison (1999) used a nationally based sample of 21,204 adults to examine religious activity and mortality. The data for their study came from the National Health Interview Survey that was later linked to the Multiple Cause of
Death file through the National Death Index. They calculated U.S. life expectancy estimates at age 20 by religious attendance and found that people who attend religious services more than once a week compared to those who never attend religious services had over 7 years longer life expectancy. In addition, they examined a series of logistic regression models. To obtain hazards ratios, all independent variables in these models were either dichotomous or categorical dummy variables. The independent variables included religious attendance, demographic variables (age, sex, race, and region of country), health variables (limitation in activity level, self-reported health, and more than a month in bed sick in the past year), socioeconomic variables (income and education), social ties (marital status, social activity, friends to count on, and relatives to count on) and health behavior (cigarette smoking, weight-for-height, and alcohol use).

The first model tested the effects of religious attendance and demographic variables. Additional variables were added as conceptual sets in a hierarchical fashion to test the change in the $-2 \text{Log Likelihood ratio}$. They found that the addition of social ties and health behaviors to the model reduced the association between religious attendance and mortality, indicating a mediating relation between religious attendance and mortality. However, even after all independent variables were included in the model, they found that people who never attend church have a 50% higher risk of mortality during the follow-up period than those who attend more than once a week, and those who attend weekly or less than once a week have a 20% higher risk of mortality compared to those who attend more than once a week (Hummer et al., 1999).

Another example of religious activity and its direct or indirect influence on bodily
functioning is the Koenig et al. (1997) study that examined 1,718 participants' religious activity and Interleukin-6 levels (an indicator of immune system regulation). They cite high levels of Interleukin-6 related to increasing age, impaired physical functioning, and a variety of physical diseases. They found a relation between religious activity and lower levels of Interleukin-6 even while controlling for demographics, physical health and functioning, depression, or negative life events. Controlling for the covariates weakened but did not eliminate the association.

Together, these studies indicate that religious activity may offer a unique protective effect against a variety of debilitating conditions. The studies detailed previously emphasize that a number of variables certainly play a part in the religiosity/health/mortality association. However, what these studies do not tell us are the pathways through which mediating or moderating variables influence the religious activity and mortality relation.

Mediators and Moderators of Religious Activity and Mortality

The terms mediator and moderator are not interchangeable and the determination of each variable type requires specific statistical methods. Baron and Kenny (1986) explained the moderator-mediator distinction. They emphasized that a mediator is a variable that accounts for some kind of process that occurs between the predictor or independent variable and the dependent variable (e.g., a previously significant path from the independent variable to the dependent variable is no longer significant after controlling
for the mediating variable or the magnitude of the path coefficient is reduced), while a moderator variable is postulated to be the circumstance under which an independent variable is related to a dependent variable (e.g., the independent variable by moderator variable interaction effect on the dependent variable is statistically significant). They noted that mediator variables are generally introduced into models when a strong relation is found between the independent and dependent variables. Moderator variables are often used in cases where an association between the independent and the dependent variables was unexpectedly weak or inconsistent (Baron & Kenny, 1986). A moderator is a "filter" variable, such that X acts differently on Y depending on different levels of M. For example, if a relation is found between money and health, a moderating variable may be age. The relation between money and health may not be as strong for the elderly or the young because social programs like Medicare and Medicaid provide healthcare for low-income people in these different age groups.

Because previous studies have already found that the relation between religious activity and mortality holds even when using modeling that statistically controls for social contact, functional ability, depression, and health, the purpose of this study is to extend our understanding of the interplay of these variables, their functions in a path model, and their combined effects on mortality.

Other studies have already found that one of the most debilitating conditions among the elderly is depression. Evidence shows that religious activity may act as a buffer to the effects of depression perhaps in part through providing coping strategies. In a cross-sectional study, religious activity was found to be correlated with better functional
ability and fewer symptoms of depression among women, and private religious observance for men who are disabled was also related to less depression (Idler, 1987). Idler and Kasl (1992) found, in a follow-up longitudinal study, that private religious activity provided protective effects for recently disabled men against depression. Koenig et al. (1992) found in a sample of hospitalized men that, even after controlling for demographic variables and health variables, religious coping was inversely related to depression. They stated that only religious coping from the baseline data was related to depression at a later longitudinal follow-up of these men. They speculated, based on the longitudinal data, that religious coping may therefore provide a buffering effect on depression (Koenig et al., 1992). None of these studies have specifically examined religious activity as a mediating variable between various health factors and mortality.

This study examined nine questions. The first four questions were examined through hierarchical Cox logistic regression modeling. A path analysis was used to examine whether a proposed model of interrelationships between these variables is a good fit with the data. The last four questions about mediating effects were tested using regression analyses (linear or logistic where needed). 1. Does religious activity account for a significant amount of the variance in survival time after statistically controlling for age, gender, cardiovascular health, social contact, depression, and functional disability? 2. Does depression account for a significant amount of the variance in survival time after statistically controlling for age, gender, cardiovascular health, social contact, functional disability, and religious activity? 3. Does social contact account for a significant amount of the variance in survival time after statistically controlling for age, gender,
cardiovascular health, depression, functional disability, and religious activity? Because mortality has been shown to differ by age, gender, and health history, these variables will be statistically controlled for in the prior logistic regression analyses (Gage, 1990; Himes et al., 1994; Lippa, Martin, & Friedman, 2000). 4. Does gender moderate the effect of religious activity on survival time after statistically controlling for age, cardiovascular health, social contact, depression, and functional disability? 5. Does the path analysis model fit the data? 6. Does religious activity mediate the effect of functional disability on social contact, depression, or mortality? 7. Does social contact mediate the effect of religious activity on depression or mortality? 8. Does social contact mediate the effect of functional disability on depression or mortality? 9. Does depression mediate the effect of social contact or religious activity on mortality?
CHAPTER III

METHODS

Participants

The subjects that this study was conducted on are predominantly members of The Church of Jesus Christ of Latter-day Saints (LDS) (91%) and are among the longest-lived in the United States (Murray, Michaud, & McKenna, 1998). In Cache County, Utah, on January 1, 1995, there were 5,677 individuals aged 65 and older who were permanent residents of the county. All were invited to participate in the study, and 5,092 participated (90% participation rate). The Health Care Financing Administration provided a Medicare enrollee list that was used to identify participants. These individuals were contacted and were interviewed over an 18-month period. Participants were 99% Caucasian. Eighty-two percent of participants overall had at least a high school education. These individuals were first given a baseline cognitive screening and risk factor interview, and were then assessed for apparent dementia. For this paper, I excluded 335 participants found to have prevalent dementia at the time of the interview, as described elsewhere (Breitner et al., 1999). Due to continued monitoring of the population and further refinement of clinical diagnoses, 20 more participants were found to have prevalent dementia after the Breitner et al. (1999) publication (a total of 355 participants with prevalent dementia).

Additionally, 190 participants were excluded who did not give self-reported information at the time of the initial interview. Of these participants, 868 did not return a mail-back questionnaire that contained the social support questions and an additional 48 returned the
questionnaire, but had either refused those questions or skipped them. This additional questionnaire was an addendum to the original baseline interview and was left in the subject’s home to be completed and returned in a postage-paid envelope. Further, 6 participants had refused or were missing the religious activity question, as well as 18 participants who had refused or were missing the depression questions. Thus, the final sample included 3,607 participants, 1,540 men and 2,067 women (see Table 1 for demographic characteristics of the sample and characteristics of the subjects who were eliminated from the sample for missing any of the above variables).

Interview Procedure

The interview content and procedure were approved by the Institutional Review Boards of Utah State University, Duke University Medical Center, and the Johns Hopkins School of Public Health. Informed consent was obtained before the interview proceeded. The interview was a face-to-face interview conducted by trained interviewers. It began with a cognitive assessment using the Modified Mini-Mental Status Examination (3MS) (Teng & Chui, 1987). Participants were then asked an extensive interview that included demographic variables, occupational, medical and medication, depression, smoking and alcohol histories, as well as an assessment of a family history of cardiovascular disease and memory problems. At the conclusion of the interview, all participants were asked to return a questionnaire that included an assessment of nutrition, exercise, and social support and were asked to return it using a postage-paid envelope.
Quality Assurance Procedures

A random (10%) sample of interviews was tape-recorded with the consent of the participant. These cassette tapes were reviewed by the interviewer’s supervisors for accuracy in procedures such as informed consent, consistency and accuracy in recording data, as well as interviewer drift from standardized protocol. Additionally, quality assurance personnel reviewed each interview for inconsistency in skip patterns or missing data. Data problems found by the quality assurance personnel were reviewed by the original interviewer. Data were entered twice to check for data entry accuracy and any discrepancies between the two data points were checked and corrected.

Measures

Religious Activity

Religious activity was measured through the following question, “About how often do you attend religious services or activities?” Available responses were 1 = never (n = 350), 2 = less than once a month (n = 276), 3 = once or twice a month (n = 275), 4 = once a week (n = 1,707), 5 = more than once a week (n = 999). Religious activity was not assessed for those participants who stated that they had no religious affiliation (n = 56 or 1.6%) and therefore a 1 (no participation in religious services) was imputed for these individuals (these 56 are included in the above frequencies).
Age

Age of the participant was measured by subtracting the subject’s birth date from the date of the baseline interview.

Cardiovascular Health

Cardiovascular health was computed as a summed composite of eight yes/no questions, each coded 0 = no, 1 = yes. This created a scaled health assessment which ranged from 0 (no cardiovascular health problems) to 8 (yes to all eight cardiovascular health problems) (see Appendix A for all scale characteristics including Cronbach alphas). A composite specifically on cardiovascular health was used due to the high mortality risk for the elderly (see Appendix B for individual questions). Cardiovascular disease ranks as the number one cause of death for those aged 65 and older (American Heart Association, 1998). Other questions related to risks for cardiovascular health (American Heart Association, 1998) were also included in this composite scale. These items included having diabetes, high blood pressure, and high cholesterol. An examination of all-cause mortality in this sample confirms that 43.7% of subjects die of cardiovascular-related problems (see Appendix C for all-cause mortality rates in this sample).

Social Contact

Social contact was measured as a set of three questions. (1) Telephone contact was measured by asking, “How often do you talk on the telephone with family, friends, or neighbors?” (2) Face-to-face contact was measured by asking, “How often do you get together with family, friends, or neighbors?” (3) Social club participation was measured by
asking, "How often do you attend meetings of social clubs, groups, or organizations such as bridge clubs, book clubs, hospital volunteer, gardening clubs, Rotary club, Kiwanis, VFW, etc.?" These three questions are coded from 1 (rarely) to 6 (usually every day) and for this study were added together for a summary measure of social contact.

Gender

Gender was coded as 0 = females and 1 = males.

Functional Disability

The functional disability scale was computed as a summed composite of 18 yes/no ADL questions that assessed the participant's need for assistance (see Appendix C for individual questions).

Depression

Depression was assessed through a modified version of the Diagnostic Interview Schedule (Robins, Helzer, Croughan, & Ratcliff, 1981). All participants were asked three screening questions as to whether they had experienced at any time in their life at least two weeks of feeling: (a) depressed, sad, or blue, (b) loss of interest or pleasure, or (c) irritability. If the subject endorsed any of these three screening symptoms, the subject was then asked a series of yes/no questions for current as well as prior symptoms of depression. For this study, the set of current depressive symptoms was summed to create a depression scale (see Appendix D). The depression scale was set to zero for all participants who did not endorse any of the three screening questions and therefore were not asked any specific depressive symptoms, as well as participants who did endorse at
least one screening question but did not endorse any current depression.

**All-Cause mortality**

Death dates of the participants were tracked through local obituaries as well as from a quarterly list mailed to the Cache County Memory Study by the Utah State Department of Vital Statistics. If a participant died by December 31, 2000 due to any reason, the mortality variable was set to 1 (n = 647); otherwise it remained 0 (see Appendix E for all-cause mortality rates in this sample).

**Time-at-Risk**

Time-at-risk was calculated as the number of days from the baseline interview to either the death date or December 31, 2000.
CHAPTER IV
RESULTS

Statistical Analyses

Due to the low rate of return of the mail-back questionnaire (including the missing social support data on the returned questionnaires, missing \( n = 916 \), 20% missing rate) and the other missing data in the religious activity and depression questions (\( n = 24 \)), differences between those participants who had missing data compared to those participants who did not have missing data were examined (see Table I). Because participants in the Cache County Memory Study were mostly Caucasian (5,055 out of 5,092, 99%), a missing data analysis by ethnicity was not performed.

There were statistically significant differences found between respondents with missing data versus respondents without missing data in all demographic variables except gender. Unfortunately, participants who have missing data for the present paper when compared to those who do not have missing data, are more likely to be not married, score lower on the cognitive screener, have more health problems, and have lower levels of education. However, when examining which variables are meaningfully different, only marital status (12% difference) and the cognitive screening score (2 point difference) seem to show any practical differences. This comparison indicates that the individuals who did not return the questionnaire with the social contact questions may be at even greater risk for lower levels of social contact (not married), health problems, functional disability, or possibly even mortality. Therefore, the results described in this paper are
Table 1

Missing Data Analyses

<table>
<thead>
<tr>
<th>Variables</th>
<th>Missing data</th>
<th>Not missing data</th>
<th>Test Statistic</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>n = 940</td>
<td>n = 3607</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>408 (43.40)</td>
<td>1540 (42.69)</td>
<td>$\chi^2 = 0.15$</td>
<td>.695</td>
</tr>
<tr>
<td>Female</td>
<td>532 (56.60)</td>
<td>2067 (57.31)</td>
<td>$\chi^2 = 48.79$</td>
<td>&lt; .001</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Marital status</th>
<th>n = 940</th>
<th>n = 3607</th>
<th>Test Statistic</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Married</td>
<td>546 (58.08)</td>
<td>2527 (70.06)</td>
<td>$\chi^2 = 48.79$</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Not married</td>
<td>394 (41.91)</td>
<td>1080 (29.94)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>M</th>
<th>SD</th>
<th>M</th>
<th>SD</th>
<th>Test Statistic</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>3MS score</td>
<td>87.99 (8.28)</td>
<td>90.67 (5.86)</td>
<td>t = 9.30 (df = 1186.25)</td>
<td>&lt; .001</td>
<td></td>
</tr>
<tr>
<td>Health</td>
<td>1.32 (1.29)</td>
<td>1.42 (1.33)</td>
<td>t = 2.10 (df = 1430.90)</td>
<td>.036</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>12.95 (3.04)</td>
<td>13.32 (2.82)</td>
<td>t = 3.49 (df = 4541)</td>
<td>&lt; .001</td>
<td></td>
</tr>
</tbody>
</table>

Note. See pages 15 and 16 for a description of subjects who are missing data. Missing data were calculated only for subjects who were not demented and gave their own data (n = 4547).
likely a conservative estimate of the relations between functional disability and mortality.

Hierarchical Cox regression models were used to analyze the overall effects of each of the proposed variables of interest (religious activity, depression, and social contact) on survival time (time to death) while controlling for other predictors of mortality. Because mortality has been shown to differ by age, gender, and health history, these variables were statistically controlled for in these analyses (Gage, 1990; Himes et al., 1994; Lippa et al., 2000). Unlike other survival analysis procedures (Kaplan-Meier), Cox proportional hazards regression supports both categorical and continuous covariates. Unlike traditional regression models, in Cox regression the resulting statistical test is a chi-square goodness of fit.

Hierarchical Cox regression models were calculated with age, gender, cardiovascular health, and other nontargeted predictors entered in the first block, and a targeted predictor entered in the second block. These analyses were used to test the following three questions.

**Question 1**

Does religious activity account for a significant amount of the variance in survival time after statistically controlling for age, gender, cardiovascular health, social contact, depression, and functional disability? When religious activity was added in the second block, the chi-square change from the previous block was statistically significant (see Table 2). Religious activity does contribute a statistically significant percent of the variance in survival time after controlling for the other covariates. The hazard ratio of religious activity in relation to mortality was .85 (95% CI = 0.79, 0.91). This indicates
Table 2

Cox Regression Model: Religious Activity

<table>
<thead>
<tr>
<th>Models</th>
<th>Betas</th>
<th>$\chi^2$ change</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Block 1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.08***</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>0.55***</td>
<td></td>
</tr>
<tr>
<td>Health</td>
<td>0.14***</td>
<td></td>
</tr>
<tr>
<td>Functional</td>
<td></td>
<td></td>
</tr>
<tr>
<td>disability</td>
<td>0.13***</td>
<td></td>
</tr>
<tr>
<td>Depression</td>
<td>-0.01</td>
<td></td>
</tr>
<tr>
<td>Social contact</td>
<td>-0.03*</td>
<td></td>
</tr>
<tr>
<td><strong>Block 2</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Religious activity</td>
<td>-0.16***</td>
<td>26.88 (df = 1, $p &lt; .001$)</td>
</tr>
<tr>
<td>Overall chi square</td>
<td>769.71***</td>
<td>(df = 7)</td>
</tr>
</tbody>
</table>

* $p < .05$, *** $p < .001$.

that for each level increase in religious activity, the hazard rate for death drops by 15%.

A separate Cox regression was calculated comparing the hazard ratio for subjects who attend religious activities at least once a week or more compared to subjects who attend religious activities less than once a week. The beta was -0.59, and the hazard ratio was 0.58 (95% CI = 1.45, 2.02), which indicates that subjects who attend church activities at least once a week or more are 42% less likely to die than subjects who attend church less frequently (see Figure 1) (Hosmer & Lemeshow, 1999).
Figure 1. Survival functions for religious activity while controlling for other covariates.

Question 2

Does depression account for a significant amount of the variance in survival time after statistically controlling for age, gender, cardiovascular health, social contact, functional disability, and religious activity? When depression was added in the second block, the chi-square change from the previous block was not statistically significant (see Table 3). Depression does not contribute a statistically significant percent of the variance in survival time after controlling for the other covariates.
Table 3

Cox Regression Model: Depression

<table>
<thead>
<tr>
<th>Models</th>
<th>Betas</th>
<th>( \chi^2 ) change</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Block 1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.08***</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>0.55***</td>
<td></td>
</tr>
<tr>
<td>Health</td>
<td>0.14***</td>
<td></td>
</tr>
<tr>
<td>Functional disability</td>
<td>0.13***</td>
<td></td>
</tr>
<tr>
<td>Religious activity</td>
<td>-0.16***</td>
<td></td>
</tr>
<tr>
<td>Social contact</td>
<td>-0.03*</td>
<td></td>
</tr>
<tr>
<td><strong>Block 2</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depression</td>
<td>-0.01</td>
<td>0.146 (df = 1, p = .703)</td>
</tr>
<tr>
<td>Overall chi square</td>
<td>769.71***</td>
<td>(df = 7)</td>
</tr>
</tbody>
</table>

*p < .05, ***p < .001.

Question 3

Does social contact account for a significant amount of the variance in survival time after statistically controlling for age, gender, cardiovascular health, depression, functional disability, and religious activity? When social contact was added in the second block, the chi-square change from the previous block was statistically significant (see Table 4).
### Table 4

**Cox Regression Model: Social Contact**

<table>
<thead>
<tr>
<th>Models</th>
<th>Betas</th>
<th>$\chi^2$ change</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Block 1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.08***</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>0.55***</td>
<td></td>
</tr>
<tr>
<td>Health</td>
<td>0.14***</td>
<td></td>
</tr>
<tr>
<td>Functional disability</td>
<td>0.13***</td>
<td></td>
</tr>
<tr>
<td>Depression</td>
<td>-0.01</td>
<td></td>
</tr>
<tr>
<td>Religious activity</td>
<td>-0.16***</td>
<td></td>
</tr>
<tr>
<td><strong>Block 2</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social contact</td>
<td>-0.03*</td>
<td>4.11 (df = 1, p = .043)</td>
</tr>
<tr>
<td>Overall chi square</td>
<td>769.71***</td>
<td>(df = 7)</td>
</tr>
</tbody>
</table>

* $p < .05$, ***$p < .001$.

Social contact does contribute a statistically significant percent of the variance in survival time after controlling for the other covariates. The hazard ratio for each additional level of social contact was calculated from the beta coefficient. The hazard ratio was .97 (95% CI = -.001, -.059) which indicates that for each additional gain in level of social contact (range from 3 to 18) subjects are 3% less likely to die (see Figure 2).

To test a moderator effect of gender on the relation between religious activity and mortality, a hierarchical Cox regression model was calculated with age, gender,
cardiovascular health, social contact, depression, functional disability, and religious activity entered in the first block, and an interaction term between religious activity and gender entered in the second block. This analysis was used to test the following question.

**Question 4**

Does gender moderate the effect of religious activity on survival time after statistically controlling for age, cardiovascular health, social contact, depression, and functional disability? When gender by religious activity interaction term is added in the second block, the chi-square change from the previous block was not statistically significant (see Table 5). Gender by religious activity does not contribute a statistically significant percent of the variance in survival time after controlling for the other covariates.
and therefore, in this sample, gender does not act as a moderator between religious activity and survival time. This indicates a similar association of religious activity with survival time for both genders.

Table 5

Hierarchical Cox Regression Model: Gender by Religious Activity

<table>
<thead>
<tr>
<th>Variables</th>
<th>Step 1</th>
<th>Step 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.08***</td>
<td>0.08***</td>
</tr>
<tr>
<td>Gender</td>
<td>0.55***</td>
<td>0.85***</td>
</tr>
<tr>
<td>Health</td>
<td>0.14***</td>
<td>0.14***</td>
</tr>
<tr>
<td>Social contact</td>
<td>-0.03*</td>
<td>-0.03*</td>
</tr>
<tr>
<td>Depression</td>
<td>-0.01</td>
<td>-0.01</td>
</tr>
<tr>
<td>Functional disability</td>
<td>0.13***</td>
<td>0.13***</td>
</tr>
<tr>
<td>Religious activity</td>
<td>-0.16***</td>
<td>-0.11***</td>
</tr>
<tr>
<td>Gender by religious activity</td>
<td></td>
<td>-0.09</td>
</tr>
<tr>
<td>Chi square change from previous block</td>
<td>550.96*** (df = 7)</td>
<td>2.43 (df = 1)</td>
</tr>
<tr>
<td>Overall chi square</td>
<td>769.71*** (df = 7)</td>
<td>783.71*** (df = 8)</td>
</tr>
</tbody>
</table>

*p < .05, ***p < .001.
This finding was unexpected because studies have consistently found that women across the lifespan are more religiously active and spiritual than men (Batson, Schoenrade, & Ventis, 1993; Bensen, Donahue, & Erickson, 1989; Iannaccone, 1990), which is confirmed in this sample as shown in Figure 3 ($\chi^2 = 13.74, df = 4, p = .008$). It has also been found that women live longer than men which again is confirmed in this study using a Kaplan-Meier survival analysis (Log rank = 21.06, df = 1, p < .000; see Figure 4). The Kaplan-Meier survival curves plot both censored (death has not occurred yet) and uncensored (death has occurred) data points. In this sample, women do not die as rapidly as men, as is shown in Figure 4. Therefore, rather than having an interactive effect, gender and religious activity may have parallel but separate effects when predicting survival time, which is confirmed by Figure 5.

Figure 3. Religious activity by gender.
Figure 4. Kaplan-Meier survival curves by gender.

Figure 5. Survival time by gender and religious activity.
The following structural equation model (see Figure 6) was used to test the fifth question. The structural equation statistical program EQS was used to analyze the data (Bentler, 1995). A structural equation model measures direct as well as indirect effects. Indirect effects are the effects between two variables that are mediated by one or more intervening variables. Two advantages of using structural equation modeling software over standard path analysis using regression models are that measurement error in the predictor variables is accounted for and all paths can be tested simultaneously (see Appendix F for intercorrelations). Because gender does not act as a moderating variable between religious activity and survival time (as tested in question 4 above), a separate structural equation model by each gender was not necessary.

Question 5

Is the proposed structural equation model a good fit with the data? The model chi square was 676.78, (df = 20, p < .001), which indicates the data do not fit the model. However, because the chi-square statistic is susceptible to a large N size, the Bentler-Bonett normed goodness-of-fit index (NFI) is a better indicator of goodness-of-fit and was 0.88. The NFI ranges from 0 to 1 and the closer NFI gets to 1, the better the data fit the model. Bentler (1995) stated that values greater than 0.9 are desirable. This measure indicates that the data fit the model fairly well. One of the issues in structural equation modeling is finding a good balance between having a good-fitting model and having a large number of parameters to achieve a good-fitting model (Bentler, 1995). The value of Akaike’s (1987) information criterion (AIC) is an indicator of the parsimony of the model.
Model chi square $= 676.78$, df $= 20$, $p < .001$

*Z* value for the test statistic $\pm 1.96$ for a .05 significance level

Figure 6. Structural equation model: Standardized beta coefficients.

When selecting a model from a large number of models, one should take into account both the statistical goodness-of-fit and the number of parameters that have to be estimated to achieve that degree of fit. The model that produces the minimum AIC or CAIC may be considered, in the absence of other substantive criteria, to be a potentially useful model. (Bentler, 1995, p. 92)

The AIC value for the model shown in Figure 6 was 636.78. However, the beta value for the path from time-at-risk to death is so large that the model may be a good fit due to this single variable. Therefore, another model was tested that excluded time-at-risk from the model (see Figure 7).
Model chi square = 276.78, df = 13, p < .001

*Z value for the test statistic ± 1.96 for a .05 significance level

Figure 7. Structural equation model: Excluding time-at-risk.

The overall chi square for the model dropped from 676.78 (df = 20, p < .001) to 276.78 (df = 13, p < .001), which indicates a better fit; however, both chi-square values are still statistically significant indicating the data do not fit the model. Again examining the more relevant measure of goodness-of-fit, the NFI for the second model was reduced from 0.88 to 0.86, which is not a statistically significant drop in the goodness-of-fit, but the AIC was reduced from 636.78 to 250.78. This minimal reduction in the NFI and large reduction in the AIC index indicates that the exclusion of the time-at-risk variable did not compromise the goodness-of-fit for this more parsimonious model.
In the structural equation model, depression appears to be unrelated to mortality in this sample. A separate logistic regression model was used to verify this result. By using mortality as the dependent variable and depression as the independent variable, the overall chi square for the model was $0.93$, $df = 1$, $p = .335$. Based on this analysis, depression was taken out of the last model.

In Figure 8, the final path analysis model is shown. As expected, the goodness-of-fit index for this final model increased due to the elimination of nonstatistically significant paths in the second model, $NFI = 0.87$ compared to $NFI = 0.86$ in the second model.
Again, as expected, the AIC index for the final model was reduced from 250.78 in the second model to 226.88 in the final model. The increase in the goodness-of-fit index as well as the decrease in the AIC index indicates that the final path analysis model (shown in Figure 8) is the best fit for the data.

To test the stability of the final model, two random samples were generated using an approximate 50% selection rate out of the original 3,607. The first sample included 1,810 subjects. The second sample included 1,798 subjects. The samples were generated using the SPSS filter syntax that automatically generates a random sample of cases. The results from these two subsets of the original data are shown in Figures 9 and 10.

Model chi square = 114.66, df = 10, p < .001

* z value for the test statistic ± 1.96 for a .05 significance level

Figure 9. First random sample: Cross validation.
As can be seen from Figures 9 and 10, the final model appears fairly stable and the path coefficients of the random samples do not dramatically differ from the final model shown in Figure 8. Although the final model was replicated on two subsets of this sample, it is critical not to overstate the importance of this finding. Due to the nature of structural equation modeling, it is important to remember that other models that could include other variables theorized to be important to both religious activity and mortality may fit the data just as well (Bentler, 1995; Loehlin, 1992; Raykov & Marcoulides, 2000).

Model chi square = 133.29, df = 10, p < .001

*Z value for the test statistic ± 1.96 for a .05 significance level

Figure 10. Second random sample: Cross validation.
The following questions deal with mediating effects. Baron and Kenny (1986) and Judd and Kenny (1981) proposed the following steps in establishing mediating effects.

**Mediator Step 1**

One must show that the initial variable is correlated with the outcome variable (see Figure 11). There must be an effect to be mediated from the predictor (X) to the outcome (Y); therefore, path c must be statistically significant.

**Mediator Step 2**

The initial or predictor variable (X) must be correlated with the mediator (M).

**Mediator Step 3**

One must show that the mediator is also related to the outcome variable. It is not sufficient to correlate the mediator with the outcome variable because the mediator and the outcome variable may be correlated because they are both caused by variable X.
Therefore, the initial variable X must be controlled for when establishing the effect of the mediator on the outcome variable Y. Often, this is accomplished by comparing the difference in two coefficients for the path X-Y when a mediating variable is present in the equation versus not present in the equation. A mediating effect is found when a previously statistically significant path from the independent variable to the dependent variable is no longer statistically significant or the reduction of the coefficient, after controlling for the mediating variable, is statistically significant. If M wholly mediates the X-Y relationship, the effect of X on Y while controlling for M should be reduced to zero (Kenny, 2001).

**Testing Mediation Using Structural Equation Modeling**

To test the mediation question using structural equation modeling requires constructing a set of hierarchical or nested models (Loehlin, 1992). The first step is to obtain a path analysis model with all variables, except the mediating variable, entered into the model. This is used to derive the path coefficient from X to Y without the effect of the mediating variable. Next, the path coefficient from X to Y that was derived from step 1 is then entered into another model as a fixed parameter that is not allowed to vary. In this second model, the mediating variable is added to the model. Then, a third model is calculated allowing the path from X to Y to vary freely and again the proposed mediating variable is included in the model. And finally, the difference in the chi square from the second model to the third model is compared using one degree of freedom. This tests the mediating effect of variable M on the path coefficient from X to Y. To test the first criterion stipulated by Baron and Kenny (1986), the bivariate correlations are examined for
the proposed X to Y relations in the following questions (see Table 6).

6. a. Does religious activity mediate the effect of functional disability on social contact?
   
   b. Does religious activity mediate the effect of functional disability on depression?
   
   c. Does religious activity mediate the effect of functional disability on mortality?

7. a. Does social contact mediate the effect of religious activity on depression?
   
   b. Does social contact mediate the effect of religious activity on mortality?

8. a. Does social contact mediate the effect of functional disability on depression?
   
   b. Does social contact mediate the effect of functional disability on mortality?

9. a. Does depression mediate the effect of social contact on mortality?
   
   b. Does depression mediate the effect of religious activity on mortality?

Table 6

Step 1 Mediating Effects: Correlations Between X and Y

<table>
<thead>
<tr>
<th>Variables of interest</th>
<th>Correlation coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional disability</td>
<td></td>
</tr>
<tr>
<td>Social contact</td>
<td>$r = -.10^{***}$</td>
</tr>
<tr>
<td>Depression</td>
<td>$r = .11^{***}$</td>
</tr>
<tr>
<td>Mortality</td>
<td>$r = .33^{***}$</td>
</tr>
<tr>
<td>Religious activity</td>
<td></td>
</tr>
<tr>
<td>Depression</td>
<td>$r = -.07^{***}$</td>
</tr>
<tr>
<td>Mortality</td>
<td>$r = -.16^{***}$</td>
</tr>
<tr>
<td>Social contact</td>
<td></td>
</tr>
<tr>
<td>Mortality</td>
<td>$r = -.10^{***}$</td>
</tr>
</tbody>
</table>

$^{a}$Point-biserial correlation; all other correlations are based on the Pearson statistic.

$^{***} p < .001$
All of the above correlations were statistically significant; therefore the first criterion was met. To meet Baron and Kenny's (1986) second criterion the bivariate correlations between X and M were examined (see Table 7). All of these correlations were also statistically significant and the second criterion was met.

To determine if the third criterion was met, each proposed mediating variable was tested using a nested path analysis model detailed in the above description. As shown in Table 8, based on these models, religious activity acts as a mediating variable between functional disability and social contact. In addition, social contact appears to act as a mediating variable between functional disability and mortality. Both religious activity and social contact act only as partial mediators because although the direct paths they mediate are reduced by a statistically significant amount, when the mediating variable is introduced into the model, the coefficients for the direct paths remain statistically significant.

Table 7

Step 2 Mediating Effects: Correlations between X and M

<table>
<thead>
<tr>
<th>Variables of interest</th>
<th>Correlation coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional disability → Religious activity</td>
<td>r = -.19***</td>
</tr>
<tr>
<td>Religious activity → Social contact</td>
<td>r = .26***</td>
</tr>
<tr>
<td>Functional disability → Social contact</td>
<td>r = -.10***</td>
</tr>
<tr>
<td>Social contact → Depression</td>
<td>r = -.04*</td>
</tr>
<tr>
<td>Religious activity → Depression</td>
<td>r = -.07***</td>
</tr>
</tbody>
</table>

* p < .05, ** p < .001.
Table 8

Step 3 Mediating Effects: Change in Chi Square When Controlling for Mediator

<table>
<thead>
<tr>
<th>Variables of interest</th>
<th>Mediator</th>
<th>Beta coefficients</th>
<th>( \chi^2 ) change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Fixed</td>
<td>Free</td>
</tr>
<tr>
<td>Functional Disability</td>
<td>Social Contact</td>
<td>Religious Activity</td>
<td>-0.139</td>
</tr>
<tr>
<td></td>
<td>Depression</td>
<td>Religious Activity</td>
<td>0.061</td>
</tr>
<tr>
<td></td>
<td>Mortality</td>
<td>Religious Activity</td>
<td>0.014</td>
</tr>
<tr>
<td>Religious Activity</td>
<td>Depression</td>
<td>Social Contact</td>
<td>-0.047</td>
</tr>
<tr>
<td></td>
<td>Mortality</td>
<td>Social Contact</td>
<td>-0.010</td>
</tr>
<tr>
<td>Functional Disability</td>
<td>Depression</td>
<td>Social Contact</td>
<td>0.058</td>
</tr>
<tr>
<td></td>
<td>Mortality</td>
<td>Social Contact</td>
<td>0.019</td>
</tr>
<tr>
<td>Social Contact</td>
<td>Mortality</td>
<td>Depression</td>
<td>0.000*</td>
</tr>
<tr>
<td>Religious Activity</td>
<td>Mortality</td>
<td>Depression</td>
<td>-0.007</td>
</tr>
</tbody>
</table>

*Path is not statistically significant; \( \chi^2 \) change is based on df = 1.

*p < .05, **p < 0.01
In summary, the Cox regression results indicate that both religious activity and social contact contribute a statistically significant amount of variance in survival time after controlling for other covariates that relate to mortality, but depression does not, with religious activity providing more protection against mortality than social support. Subjects who attend church activities at least once a week or more are 41.6% less likely to die than subjects who attend church less frequently. Subjects who increase their social contact frequency by one level gain 3% protection against mortality. The structural equation models confirm that in this sample, depression is not related to mortality, which may be due to the restricted variability in the depression variable.

Perhaps the most interesting findings are the relations found among religious activity, social contact, functional disability, and mortality. Figure 12 summarizes only the mediating effects within the structural equation model.

Figure 12. Mediation effects among religious activity, social contact, functional disability, and mortality.
CHAPTER V
DISCUSSION

This goal of this study was to examine hypotheses about the interconnectedness of public religious activity, social contact, functional disability, depression, and all-cause mortality. Both religious activity and social contact were found to be directly related to both mortality and survival time. Results from the structural equation models indicate that social contact is a crucial underlying mechanism that is triggered by religious activity and acts as a partial mediator between functional disability and mortality. Also, based on the structural equation models, religious activity acts as a partial mediator between functional disability and social contact. Although in the structural equation model depression was related to both functional disability and religious activity, it was not related to either social contact or mortality.

The most interesting findings from this study are the interrelations found between functional disability, which is the strongest predictor of mortality in the structural equation model, and both social contact and religious activity. These relations are not clear when only Cox regression models are used to analyze this type of data. If Cox regression was the only statistical approach used, the finding that religious activity accounts for more of the variance in survival time than social contact would appear to be straightforward. Using this method, one may erroneously conclude that religious activity is a more salient variable than social contact in predicting survival time when controlling for other predictors of mortality.
By using structural equation modeling, in particular the nested structural equation models used to test mediational effects, the complexity of relations between religious activity, social contact, and mortality is more thoroughly explored. In this sample, religious activity does not act as a mediating factor between any other variable and mortality. But it does act as a partial mediator between functional disability and social contact while social contact is the only factor that acts as a partial mediating variable between functional disability and mortality (see Figure 12). Neither mediating effect is strong, suggesting that direct effects remain, but entering the mediating factors in the model reduces the strength of the direct path by a statistically significant margin.

The mediating effect of religious activity between functional disability and social contact indicates that it is through religious activity that functional disability affects social contact. This may be due to characteristics of the dominant religion (The Church of Jesus Christ of Latter-day Saints—LDS) in this area. Those subjects who are members of the LDS church and are active churchgoers have a broad social experience at church. If members are not physically able to go to church, their social experience becomes very restricted. Even though the LDS church has regulated social contacts, which include monthly visits from other members of their local church, help in preparing food, doing housework, monitoring emotional and cardiovascular health status, or providing food and/or financial assistance where necessary, these outreach activities do not make up for the social contact available through church attendance. The results indicate that a decline in functional ability, in combination with a resulting decline in church attendance, creates a higher risk for mortality. One of the disadvantages of this study is the correlational
nature of the data; causality cannot be inferred regarding whether a decline in functional ability causes a decline in church attendance.

Although religious activity is the most statistically significant factor in the Cox regression models on survival time, and although both religious activity and social contact are directly related to mortality in the structural equation model, only social contact also provides some mediation between functional disability and mortality. Although social contact has been found to be a factor in predicting mortality (Avlund et al., 1998; Eriksson et al., 1999; House et al., 1982), it has not been clear in previous research that social contact may act as a partial mediator between functional disability and mortality. Again, although Hummer et al. (1999) did show a relation between religious activity and mortality, religious activity’s mediating effect between functional disability and social contact has never been explored before. Nevertheless, this effect of religious activity may be unique to this sample because of the centrality of religious activity in the social lives of people in this culture.

These findings have implications for further research in this area. It is not surprising that both religious activity and social contact were related to functional disability and mortality, particularly when the only measure of religious activity in this study is a measure of public religious activity rather than private religious activity. Public religious activity will be more likely to engage a social network response to any problems the subject may be having. A more interesting question may be whether private religious activity is also related to either functional disability or mortality.

The effects found among functional ability, religious activity, and mortality have been recently shown when examining private religious activity (Helm, Hays, Flint,
Koenig, & Blazer, 2000). Helm et al. (2000) theorized that subjects who were praying regularly out of habit, compared to those who were “praying under duress” due to failing health, would have a survival advantage. They operationalized this by analyzing religious activity (and other covariates) within two groups, the ADL impaired and unimpaired. They examined the effects of private religious activity after controlling for other covariates including health practices, social support, and other religious practices. They found a significant survival advantage for subjects reporting private religious activity in the ADL unimpaired group, but not in the ADL impaired group. They suggest that “the relatively subtle effects of private religious activity are not sufficient to overcome the overwhelming force exerted on mortality by health decline to the point of ADL impairment” (Helm et al., 2000, p. M403).

The results of this study suggest that the effects of public religious activity related to social networking benefits as well as benefits that are beyond the scope of social networking. The benefits from either public or private religious involvement could be derived from an improved psychological state (Levin, 1996), better coping methods (Pargament et al., 1988), or stress reduction (Kark et al., 1996), psychological benefits that are also linked to physical benefits.

Unexpectedly, depression, this study’s measure of psychological well-being, does not appear to be related to mortality in this sample. This may be due to the operationalization of depression in this study. Because the depression questions were not asked of subjects who did not endorse the initial screening questions, for these subjects the depression scale was imputed to zero. Therefore, there is serious restriction of
variability for this scale (see Appendix A). Even though responses to the scale range from 0 to 10, the mean is only .26.

Chronic depression or major depression may be more toxic for cardiovascular health than merely whether one is experiencing any kind of current depressive symptoms. However, depression has not been shown to be a clear predictor of mortality in previous literature. Although studies have found relations between current depressive status and current physical health (Irwin et al., 1990) as well as relations between current or chronic depressive status and future health (Helmer & Bargerger-Gateau, 1999; Leserman et al., 1997; Schwartzman & Glaus, 2000; Whooley & Browner, 1998), other studies have found that depressive symptoms are not related to various measures of physical health when controlling for other psychosocial predictors (Colantino et al., 1992; Devins et al., 1990; Hays, Schoenfeld, Blazer, & Gold, 1996). These inconsistent findings indicate the complex nature of depression and variables that are related to it. Depression continues to be ambiguous in its relation to mortality.

Limitations of this study include problems with the measures used. Both the health measure and the social contact measure had Cronbach’s alpha levels less than 0.55. These low alpha levels may indicate greater measurement error, but also may indicate unrelated items in the scale. In either case, the scales may not be capturing the intended construct.

The single item that measured religious activity lacks any indication of long-term religious activity levels that may be more relevant for predicting social contact and mortality. It also does not address personal versus public religious beliefs or practices. Personal religious practices may be more interesting to examine in relation to mortality.
because these personal religious practices could be less correlated with social contact and therefore would be a more encapsulated measure of religious practices. Further, this item was not directly asked for those subjects who did not endorse any religious affiliation and the imputed one (no religious attendance) may have introduced an unacceptable amount of measurement error. The depression scale has the same imputation problem in that subjects were not directly asked current depressive symptoms if they did not endorse any lifetime symptoms of depression. This assumption that current depressive symptoms are zero if no endorsement of lifetime symptoms was made may not be very accurate, but these data provide no avenue for exploring the possible measurement error in either the depression or the religious activity variables.

Another limitation is the generalizability of this sample. Because this sample is overwhelmingly homogeneous with regard to religious affiliation, ethnicity, and culture, the generalizability of the results to another population could be limited. Results about religious activity should be viewed with particular caution.

To meaningfully extend this research, the next step should be an examination of the specific ways social contact mediates the relation between functional disability and mortality. Various strategies may include examining outcomes of social contact like feelings of belonging or having a reason to live. A future study should examination which characteristics of social contact are most beneficial in reducing the risk of mortality. These characteristics could include type of social contact (members of local church, caregivers, friends, or family) as well as the level of satisfaction associated with each type of social contact. Level of satisfaction alone may not be as salient to mortality as a more specific feeling of belonging or having a reason to live that is associated with
each different type of social contact. This more thorough examination of social contact
would not be complete without more meaningful measures of religious activity. The
construct of religious expression or behavior is multifaceted and should be measured as
such. Multiple items should be used in longitudinal measures of both public and private
religious activities. These longitudinal measures of religious involvement would help
distinguish between subjects who are “praying in a foxhole (i.e., offering prayer in times
of need at the end of life) and those who may have had a long-term habit of private
devotionals” (Helm et al., 2000).

To augment research on the benefits of religious activity, qualitative research
could prove to be insightful. Questions should be asked regarding the meaning of
religious activity, because activity or attendance is not the same thing as more general
religious experiences, beliefs, or behavior in any religious paradigm. It would also be
illustrative to explore what factors underlie meaningful religious behaviors or experiences
and how those factors relate to social networks, functional disability, or depression. Kark
et al. (1996) proposed five ways that religion may reduce stress, and which I propose may
also be factors beneficial to physical health. These factors include a sense of belonging
and a coherent world view, a relaxation response to regular prayer, a belief in the
Almighty and a belief in direct guidance from God, a carefully regulated lifestyle (diet,
etc.), and strong marital ties due to social pressure in orthodox religions against divorce.
These may be underlying factors that play important roles in why religious activity is so
strongly related to mortality and these factors should be investigated more explicitly.

Further investigation into depression and relations with social contact and
religious activity would be facilitated through the use of broader measures of depression
that would include chronicity and severity. All measures, whether it be measures of the chronicity and severity of depression or measures of the characteristics of social contacts, are less prone to measurement error if a study is prospective in nature. It is difficult to obtain an accurate assessment of the effects on mortality in the elderly with only correlational data. Although the structural equation models look causal, in this study, they remain correlational in nature. A prospective study design would strengthen this type of study.

In conclusion, despite several limitations, this study suggests that both religious activity and social contact converge in their effects on mortality. Although religious activity is directly related to mortality, it appears to influence the way that functional disability affects social contact. Social contact, in turn, is one way that functional disability affects mortality.

These findings indicate that even after controlling for other variables known to influence mortality, religious activity is a strong direct predictor of mortality. This is not a new finding, as discussed in a meta-analytic review of the literature on religious involvement and mortality (McCullough et al., 2000). However, what is unusual about this study are the interrelations found among functional ability, social contact, and religious activity.

It is evident from these results that this area of research is more complicated than many of our theories would suggest. This study has provided good evidence that religious activity and social contact have important implications for the health of the elderly in northern Utah. Nevertheless, many multilayered aspects of religious behavior or expression and social networks have not been addressed here. Future work investigating
the consequences of the longitudinal aspects of religious behavior, social networking, and depression is needed.
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Appendix A. Scale Characteristics
Table 9

Scale Characteristics

<table>
<thead>
<tr>
<th>Scale</th>
<th>Number of Items</th>
<th>Actual</th>
<th>Possible</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Standardized Cronbach Alpha</th>
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</thead>
<tbody>
<tr>
<td>Age</td>
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<td>64-100</td>
<td>na</td>
<td>74.63</td>
<td>6.64</td>
<td>na</td>
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<tr>
<td>Health</td>
<td>8</td>
<td>0-8</td>
<td>0-8</td>
<td>1.32</td>
<td>1.29</td>
<td>.54</td>
</tr>
<tr>
<td>Functional disability</td>
<td>18</td>
<td>0-16</td>
<td>0-18</td>
<td>1.14</td>
<td>2.29</td>
<td>.87</td>
</tr>
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<td>Social contact</td>
<td>3</td>
<td>3-18</td>
<td>3-18</td>
<td>12.32</td>
<td>2.63</td>
<td>.50</td>
</tr>
<tr>
<td>Depression</td>
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<td>0-10</td>
<td>0-10</td>
<td>0.26</td>
<td>1.25</td>
<td>.93</td>
</tr>
<tr>
<td>Religious activity</td>
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<td>1-5</td>
<td>1-5</td>
<td>3.76</td>
<td>1.21</td>
<td>na</td>
</tr>
<tr>
<td>Time-at-risk</td>
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<td>5-2096</td>
<td>na</td>
<td>1799.58</td>
<td>414.98</td>
<td>na</td>
</tr>
</tbody>
</table>

Note. N=3607, na = not applicable.
Appendix B. Cardiovascular Health Composite Variables
Cardiovascular Health Composite Variables

1. Has a doctor or nurse ever told you that you had a stroke?
2. Has a doctor or nurse ever told you that you had a transient ischemic attack or mini-stroke?
3. Have you been told you had angina?
4. Have you ever had high blood pressure or been told that you had hypertension?
5. Have you ever been told you have high cholesterol or blood lipids?
6. Have you ever had coronary bypass surgery?
7. Have you ever had a heart attack, myocardial infarction, or coronary thrombosis?
8. Have you ever had diabetes, high blood sugar, or sugar in the urine?
Appendix C. All-Cause Mortality Rates
<table>
<thead>
<tr>
<th>Cause of death</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart attack</td>
<td>104</td>
<td>16.1&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Cancer</td>
<td>98</td>
<td>15.1</td>
</tr>
<tr>
<td>Other cardiac disorders</td>
<td>56</td>
<td>8.7&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>31</td>
<td>4.8</td>
</tr>
<tr>
<td>Other cerebro-vascular disease</td>
<td>26</td>
<td>4.0&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Congestive heart failure</td>
<td>20</td>
<td>3.1&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Other pulmonary or unspecified pulmonary/respiratory disorders</td>
<td>20</td>
<td>3.1</td>
</tr>
<tr>
<td>Strokes or transient ischemic attacks</td>
<td>20</td>
<td>3.1&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Other cardiovascular disease (including atherosclerosis)</td>
<td>19</td>
<td>2.9&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Coronary artery disease/angina</td>
<td>17</td>
<td>2.6&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>16</td>
<td>2.5&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>COPD or emphysema</td>
<td>14</td>
<td>2.2</td>
</tr>
<tr>
<td>Spinal cord disorders</td>
<td>10</td>
<td>1.5</td>
</tr>
<tr>
<td>Other digestive disorder</td>
<td>8</td>
<td>1.2</td>
</tr>
<tr>
<td>Parkinson’s disease</td>
<td>7</td>
<td>1.1</td>
</tr>
<tr>
<td>Renal disease and urological disorders</td>
<td>7</td>
<td>1.1</td>
</tr>
<tr>
<td>Other dementia</td>
<td>6</td>
<td>.9</td>
</tr>
</tbody>
</table>

(table continues)
<table>
<thead>
<tr>
<th>Cause of Death</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trauma</td>
<td>6</td>
<td>.9</td>
</tr>
<tr>
<td>Alzheimer’s disease</td>
<td>5</td>
<td>.8</td>
</tr>
<tr>
<td>Hypertension</td>
<td>5</td>
<td>.8&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Liver disease (including cirrhosis)</td>
<td>5</td>
<td>.8</td>
</tr>
<tr>
<td>Infections</td>
<td>4</td>
<td>.6</td>
</tr>
<tr>
<td>Anemia</td>
<td>3</td>
<td>.5</td>
</tr>
<tr>
<td>Other musculo-skeletal disorders</td>
<td>3</td>
<td>.5</td>
</tr>
<tr>
<td>Other nutritional or metabolic disorder</td>
<td>3</td>
<td>.5</td>
</tr>
<tr>
<td>Peritoneal disorders</td>
<td>3</td>
<td>.5</td>
</tr>
<tr>
<td>Gastrointestinal bleed</td>
<td>2</td>
<td>.3</td>
</tr>
<tr>
<td>Other blood disease</td>
<td>2</td>
<td>.3</td>
</tr>
<tr>
<td>Rheumatoid arthritis</td>
<td>2</td>
<td>.3</td>
</tr>
<tr>
<td>Other miscellaneous</td>
<td>10</td>
<td>1.5</td>
</tr>
<tr>
<td>Unspecified</td>
<td>36</td>
<td>5.6</td>
</tr>
<tr>
<td>Missing cause of death</td>
<td>79</td>
<td>12.2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>647</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

<sup>a</sup>Deaths due to cardiovascular-related health problems (43.7%).
Appendix D. Activities of Daily Living (ADL) Questions
Activities of Daily Living (ADL) Questions

1. Do you need assistance with bathing or grooming (for example running bath water, getting into or out of the tub, or washing body and hair)?

2. Can you walk long distances (> 1 block) without assistance?

3. Do you use a cane, a walker, or some other sort of assistance?

4. Do you need help traveling beyond walking distance (such as using the bus system or driving yourself)?

5. Do you need help getting into or out of a bed or chair?

6. Do you need help using the restroom (including adjusting clothing or getting onto or off of the toilet)?

7. Do you need reminders to use the restroom?

8. Do you need help preparing meals for yourself (for example a hot meal, a sandwich, a TV dinner, or microwaving a meal)?

9. Do you need assistance with eating (for example, serving food, using utensils, or drinking from a glass or cup)?

10. Do you need assistance doing the laundry? This includes putting clothes into the washer and dryer, starting the machines, and unloading them when they are finished.

11. Do you need help doing light housework such as dusting, washing dishes, or sweeping?

12. Do you need help doing heavier chores such as vacuuming, yard work, moving furniture, or scrubbing?
13. Do you need any assistance using the telephone, either answering the phone or placing calls? This would include an amplifier, larger push buttons, or preprogrammed phone numbers.

14. Do you need assistance with any kind of shopping (not including transportation)?

15. Do you need assistance with shopping for groceries and prescriptions?

16. Do you need assistance shopping for things other than groceries and prescriptions?

17. Do you need assistance or reminders taking your medications?

18. Do you need help managing your finances, such as paying your bills or managing your checkbook?
Appendix E. Depressive Symptoms
Depressive Symptoms

1. Have people told you recently that you look sad or down?
2. Has your appetite recently increased or decreased?
3. Have you recently lost or gained weight?
4. Have you recently had difficulty sleeping or have you been sleeping too much?
5. Do you feel either slowed down, or restless and fidgety?
6. Do you have low energy, feel tired out, or fatigued?
7. Do you have feelings of guilt or worthlessness?
8. Do you have unusual trouble concentrating, thinking, or making decisions?
9. Have you been thinking about death or suicide?
10. Have you told your doctor about your current depression, loss of interest and pleasure, or irritability?
Appendix F. Intercorrelations of All Independent and Dependent Variables
Table 11

Intercorrelations of All Independent and Dependent Variables

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Age</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Health</td>
<td>.019</td>
<td>1.000</td>
<td>.261</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Functional disability</td>
<td>.361</td>
<td>.143</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Social contact</td>
<td>-.030</td>
<td>-.027</td>
<td>-.100</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Depression</td>
<td>-.016</td>
<td>.071</td>
<td>.114</td>
<td>-.037</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Religious activity</td>
<td>-.069</td>
<td>-.034</td>
<td>-.193</td>
<td>.257</td>
<td>-.066</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Gender</td>
<td>-.069</td>
<td>.019</td>
<td>.120</td>
<td>-.160</td>
<td>-.050</td>
<td>-.054</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Time-at-risk</td>
<td>-.238</td>
<td>-.121</td>
<td>-.296</td>
<td>.110</td>
<td>-.007</td>
<td>.152</td>
<td>-.077</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>9. Death</td>
<td>a.299</td>
<td>a.110</td>
<td>a.325</td>
<td>a.100</td>
<td>a.016</td>
<td>a.159</td>
<td>b.074</td>
<td>a.808</td>
<td>1.000</td>
</tr>
</tbody>
</table>

Note: N=3607

a Point-biserial correlation, b Phi correlation.
CURRICULUM VITAE

Andrea D. Hart
(April, 2001)

EDUCATION:

B.A. (1991) Utah State University (Liberal Arts)
M.S. (1996) Utah State University (Family and Human Development)
Ph.D. (expected 2001) Utah State University (Family and Human Development)

HONORS:

Golden Key National Honor Society
Phi Kappa Phi National Honor Society
1994 College of Family Life Graduate Student Senator of the Year
1996-97 Research Vice Presidential Fellowship

TEACHING EXPERIENCE:

Children in the Middle Years (Instructor, Spring 2001)
Lifespan Development (Instructor, Fall 2000)
The Child from 2 to 5 (Instructor, Winter, 1995)
Understanding Infants (Instructor, Spring, 1994)
Research Methods (Teaching Assistant, Fall, 1993)
Human Sexuality and Family Relations (Teaching Assistant, Spring, 1993)
Lifespan Development (Instructor, Winter, 1993)
The Child from 2 to 5 (Teaching Assistant, Winter, 1992)
Guidance of Children (Teaching Assistant, Fall, 1992)

SCHOOL INVOLVEMENT:

Graduate Student Senator Department of Family and Human Development (1993-1994).
Chair of the Graduate Student Senate Activities and Awareness Committee (1994).

RESEARCH EXPERIENCE:
Cache County Memory Study (Utah State University, 1995-present). Longitudinal population research study done in cooperation with Duke University and The Johns Hopkins University to assess factors in memory loss and/or retention in the elderly.
Head Start Family Service Center Project Evaluation (Utah State University, 1991-1994). Three-year program evaluation of project designed to coordinate services to Head Start parents in the areas of literacy, employment, and substance abuse.

From 1 to 7 and Parent-Toddler Play Project (Utah State University, 1990-1995). Continuation of studies on individual differences in play behavior comparing previous findings to those from younger samples followed longitudinally, from 10 months to 7 years.

Children’s Clothing and Attractiveness (Utah State University, 1991-1992). Study of how children’s clothing, attractiveness, and gender affect how they are perceived by adults and peers.

PROFESSIONAL DEVELOPMENT:

Professional Affiliation
- Society for Research in Child Development (SRCD)
- American Psychological Association (APA)
- Southwestern Society for Research in Human Development (SWSRHD)

Professional Publications


Conference Presentations
Cache County Study. Southwestern Society for Research in Human Development, Galveston, TX


Professional Service

Reviewer for Southwestern Society for Research in Human Development (1994)

Local Arrangements Committee (1993-1996) for Southwestern Society for Research in Human Development


COMMUNITY SERVICE:

Public Service Presentations


Public Service Reports

