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Emotional Distress and Cognitive Functioning of Older Couples: A Dyadic Analysis

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Abstract

This paper examines the relationship between cognitive functioning and emotional distress in a sample of 2,684 married couples from the 2006 and 2008 Korean Longitudinal Study of Aging surveys. Using the Center for Epidemiologic Studies Depression (CESD) scale and the Mini-Mental State Exam (MMSE), we examine longitudinal interrelation between emotional and cognitive health for individuals and spouses. We test how emotional distress and cognitive impairment affect each other for individuals and how these for one spouse may affect the other. We find emotional distress contributes to cognitive impairment for wives, but not for husbands. We also find emotional distress and cognitive impairment in one spouse affects that in the other, although the emotional distress of wives affects husbands' more than that of husbands affects wives'. We find no evidence indicating that emotional distress of one's spouse affects one's own cognitive impairment or that the cognitive ability of one's spouse leads to one's own emotional distress.

Introduction

Emotion is inextricably linked to cognition. Emotion is involved in cognitive processes, and cognitive judgment contributes to emotion (Hendrie et al., 2006). The simultaneous investigation of emotion and cognition has therefore been highly recommended (Hendrie et al., 2006; Steffens at al., 2006). To date, however, there has been little such research, particularly for middle-aged, non-white, or non-US populations (Siegel et al., 2004; Townsend et al., 2001; Peek et al., 2006).

Filling this void, we simultaneously examine emotion and cognition of middle-aged and older adults in Republic of Korea (hereafter Korea). We begin below with a review of previous research on aging, depression, and cognitive health. We then review previous findings on individual emotional and cognitive health of older adults and on how couples affect the emotional and cognitive health of each other. From this review, we pose three sets of research questions and hypotheses on how cognitive and emotional health may change for individuals and couples. We then present empirical findings and conclude with a discussion of how our findings compare with previous literature.

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Physical and cognitive health declines with aging, and such decline may contribute to emotional distress (Ayotte, Yang, and Jones, 2010; Anstey et al., 2007). At the same time, some longitudinal studies have found that a prior history of depression may increase the risk of cognitive decline (Chodosh et al., 2007; Dotson, Resnick, & Zonderman, 2008). The question of whether emotional distress leads to cognitive decline, or cognitive impairment contributes to emotional distress remains controversial (Gerstorf, Hoppmann, Kadlec, & McArdle, 2009). We investigate this longitudinal interrelationship, using a dynamic modeling approach.

Aging does not take place in isolation, but rather in a social context, with spouses sharing many life experiences and most immediate interpersonal context (Gerstorf, Hoppmann, Anstely, & Luszcz, 2009; Gerstorf, Hoppmann, Kadlec, & McArdle, 2009). Previous cross-sectional studies have shown spouses have similar health, including similar levels of emotional distress and cognition, referred to as health concordance (Meyler, Stimpson & Peek, 2007). The similar levels or correlation of emotional distress between spouses has been explained by multiple theories: emotional contagion, that one spouse's mood contributes to the other's (Siegel et al., 2004; Hatfield, Cacioppo, & Rapson, 1993); shared environment, where both spouses are exposed to stressful circumstances that affect their emotional well-being (Tower & Kasl, 1996); and assortative marriage, by which those with similar emotional, social, and economic traits are attracted to one another (Eagles et al, 1987; Lillard & Panis, 1996).

These theories can also explain concordance for cognition. Cognitive stimulation from one spouse may influence the other's cognitive functioning (Dufouil & Alpérovitch, 2000). Both spouses may experience cognitive stimulation from shared environment (Gerstorf, Hoppmann, Kadlec, & McArdle, 2009). Through assortative marriage, those with similar cognitive ability tend to marry each other (Siegel et al., 2004).

Previous research also suggests cross-domain effects, by which cognitive impairment of one spouse leads to emotional distress of the other (Shulz & Martire, 2004 Bedard et al., 2005; Baum et al., 2009). Similarly, a depressed spouse may withdraw socially, leaving the other spouse without social interaction and cognitive stimulation (Dufouil & Alpérovitch, 2000).

Beyond cross-sectional association, our understanding of longitudinal influence of one spouse's emotional and cognitive health on the other is still limited. In this study, we take a dyadic approach (Kenny, 1988; Kenny, 1996) to examine longitudinal effects in emotional distress and cognitive impairment both for couples and the individuals that comprise them.

Previous literature on dyadic analyses of emotional and cognitive health has focused on non-Hispanic whites. We seek to expand this focus in part because how spouses influence the emotional and cognitive health of each other may be subject to cultural context (Peek et al., 2006). No study, to our knowledge, has examined spousal influences on emotional and cognitive health among Korean couples.

Korean families, like those in other East Asian countries (Zeng & Wang, 2003; Ministry of Internal Affairs and Communications, Statistics Bureau, Japan, 2010), have become increasingly similar to Western ones, particularly in shifting from a traditional extended

family structure and toward a couple-centered nuclear family as urbanization and industrialization increase (Deuchler, 1992). As a result, couple interaction is increasingly important. Increased life expectancy and lowered retirement age are also increasing the time Korean couples spend with each other (Lee & Smith, 2009), providing more opportunity for spouses to affect the health of each other.

Both depression and cognitive impairment are important public health concerns in Korea, particularly among the older population (Choi et al., 2008; Lee & Smith, 2009; Belluck, 2010). More than 90 percent of those who commit suicide have a diagnosable psychiatric disorder, most frequently depression and substance abuse (Conwell & Brendt, 1995). The suicide rate, 26 per 100,000 persons in 2008, has tripled since the 1990s and is currently one of the highest in the world (Lee & Smith, 2011). Suicide rates increase with age and are highest among the elderly. The suicide rate for Koreans between 45 and 54 is three times the U.S. rate and twice the U.K rate; while that for Koreans between 65 and 74 is ten times the U.S. rate and five times the U.K. rate (WHO, 2006). Studies over the last decade have estimated the prevalence of dementia in Korea to be between 6.3 and 11.5 percent (Cho et al., 2011). Recent estimates suggest 31 percent of Koreans at least 65 years of age and 47 percent of those at least 85 years of age have non-dementia cognitive impairment (Choo et al., 2009), compared to just 22 percent of the U.S. population at least 70 years of age (Plassman et al., 2008).

Intrapersonal emotional and cognitive health of older adults

For older adults, emotional distress and cognitive impairment are common and correlated (Hendrie et al., 2006), but the theories of how emotional distress and cognitive impairment are interrelated remain controversial. Dysfunction in concentration is one of the key diagnostic criteria of emotional disorders, with the inability to concentrate negatively influencing the development of cognitive reserve (Steffen & Potter, 2008). Depressed feelings may occupy and distract substantial portions of cognitive resources, reducing cognitive performance (Gerstorf, Hoppmann, Kadlec, & McArdle, 2009; Gerstorf, Hoppmann, Anstely, & Luszcz, 2009; Macdonald, Hultsch, & Bunce, 2006). Emotions may also affect cardiovascular and immune functioning, with subsequent long-term effects on the brain and cognitive performance (Danner et al., 2001; Kiecolt-Glaser, McGuire, Robles, & Glaser, 2002).

While the cross-sectional correlation between depression and cognitive abilities such as processing speed, episodic memory, and executive function is well established, longitudinal studies are inconclusive on whether poor emotional health leads to cognitive decline (Steffens et al., 2006). Some longitudinal studies have found that a prior history of depression increases the risk of cognitive decline (Chodosh et al., 2007; Dotson,Resnick, & Zonderman, 2008). Other research also suggests that emotional disorders in childhood lead to poor cognitive development (Currie & Stabile, 2004; Fletcher & Wolfe, 2007). Yet Vinkers et al. (2004) found no effect of baseline depressive symptoms on subsequent cognitive decline but rather that baseline cognitive impairment accelerated the appearance of subsequent depressive symptoms.

Cross-sectional health concordance of couples

Recent literature has increasingly focused on similarities in spouses' health status, that is, their "health concordance" (see Meyler, Stimpson & Peek, 2007 for review). There is abundant empirical evidence on the positive correlation of emotional distress between spouses (Bookwala & Schulz, 1996; Siegel et al., 2004; Tower & Kasl, 1995). Previous research has also found concordance of cognitive health while controlling for spouses' educational attainment. Dufouil and Alpérovitch (2000) found weak but significant positive correlations for spouses on global cognitive functioning and verbal fluency after controlling for age, education, alcohol use, psycho-pharmaceutical use and depressive symptoms.

As earlier noted, there are several theories to explain health concordance of couples. First, couples may influence each other through emotional contagion. According to social interaction theory (Coyne, 1976), depressed individuals may seek both excessive reassurance and negative feedback from those close to them. That is, they seek reassurance while doubting its sincerity. Although those close to persons with depressive symptoms may at first be supportive, over time they may become frustrated and less supportive. This cycle of excessive reassurance and negative feedback can cause individuals close to those with depressive symptoms to develop their own such symptoms. That is, depressed individuals may spread their depression to spouses through emotional contagion (Hatfield, Cacioppo, and Rapson, 1993).

Second, social interaction theory may help explain concordance in cognitive health through cognitive stimulation. Cognitive declines accelerate in the absence of intellectual stimulation (Salthouse, 2006). A cognitively impaired spouse is likely to provide less intellectual stimulation.

Third, shared resources and environment may explain health concordance. Spouses share resources such as social capital or financial resources that affect levels of emotional distress (Gerstorf, Hoppmann, Anstely, & Luszcz, 2009). These shared levels of resources may also affect levels of cognitive stimulation for both partners (Gerstorf, Hoppmann, Kadlec, & McArdle, 2009; Tower & Kasl, 1996)

Fourth, assortative mating, by which individuals marry those with similar demographic, education, and health characteristics, may explain emotional health concordance (Lillard & Panis, 1996). Education contributes to development and maintenance of cognitive reserves (Scarmeas & Stern, 2004). High correlation between spouses' educational attainments attributable to assortative matching may result in high correlation between spouses' cognition (Reynolds, Baker, & Pedersen, 2000; Lee, J., 2010). Similarly, empirical evidence suggests that those with similar emotional states are attracted to each other (McCrae et al., 2008), subsequently leading to spouses having similar emotional traits.

Longitudinal interrelation between spouses

A few recent studies have examined longitudinal interrelation between spouses' emotional and cognitive health. Using the Center for Epidemiologic Studies Depression (CESD) scale, Siegel et al. (2004) found, after adjusting for a range of characteristics, CESD scores

between the respondent and those of his or her souse in the prior year to be significant associative after adjusting for a range of respondent and spouse characteristics. Peek et al. (2006) also found, among a sample of Mexican-American spouses, husband's CESD score affects that of the wife, but a wife's CESD score not affecting that of the husband. Similarly, Kouros and Cummings (2010) found that greater depressive symptoms among husbands were a significant predictor of subsequent depressive symptoms in wives, but that wives' depressive symptoms did not subsequently lead to depressive symptoms in husbands. Gerstorf, Hoppmann, Anstely, & Luszcz, (2009), however, found that wife's depressive symptoms were a significant predictor of a subsequent increase in husband's depression, but that husband's depressive symptoms did not affect wife's depressive symptoms.

Previous research has also found asymmetric effects between husband and wife for cognition. Gerstorf, Hoppmann, Kadlec, & McArdle (2009) found that husbands' memory loss predicts subsequent memory decline among wives, but no evidence of such an effect by wives on husbands. They also found, among couples at least 75 years of age, that wives' depressive symptoms precede steeper memory decline among husbands but that husbands' depressive symptoms predicted better memory functioning over time for wives. There have been several attempts to explain such differences in the direction of relationship, including analyses of cultural differences across racial/ethnic groups (Peek et al, 2006) and closeness in the relationship (Tower & Kasl, 1996). Peek et al. (2006) found that among Mexican-Americans, husbands' depression associate with wives' emotional health, but that this was unidirectional. Tower and Kasl found that spouse interactions were only prevalent among couples that were closely bonded emotionally.

The literature on dementia care giving finds that the care-giving spouse, particularly if female or older, often experiences emotional distress (Shulz & Martire, 2004). This is not surprising, given the well-documented emotional burden of caring for older persons with disabilities (Shultz & Martire, 2004). Asymmetric gender roles may account for the greater emotional burden women have in caring for their spouses.

Research question and hypotheses

We seek to expand previous research in two ways. First, we simultaneously examine emotional and cognitive health, including their interrelations. Second, we use a dyadic approach to analyze dependency between spouses. This approach helped us simultaneously examine how one's health affects, and is affected by, that of one's spouse. Previous research analyzed data on husbands and wives separately or focused only on patient or care-giving spouse characteristics and outcomes.

We use a seemingly unrelated regression (SUR) modeling approach for analyzing dyadic data. This allows simultaneous examination of how emotional distress and cognitive impairment for both spouses are related after controlling for risk contributors such as age, education, chronic health conditions and functional limitations, as well as for shared resources and environment, such as family income and children.

We examine three sets of hypotheses on the relationship between emotional and cognitive health for individuals and their spouses.

First, we hypothesize actor effects that (H1a) emotional distress of an individual is associated with cognitive decline for that individual in a subsequent period, and that (H1b) cognitive impairment of an individual is associated with emotional distress for that individual in a subsequent period.

Second, we hypothesize within-domain spouse effects that (H2a) emotional distress of one's spouse subsequently contributes to one's own emotional distress, and that (H2b) cognitive impairment of one's spouse subsequently contributes to one's own cognitive impairment (H2b).

Third, we hypothesize cross-domain spouse effects that (H3a) emotional distress of one's spouse has a subsequent negative effect on one's own cognition, and that (H3b) cognitive impairment of one's spouse has a subsequent negative effect on one's own emotional distress.

Data

We use data from the 2006 and 2008 waves of the Korean Longitudinal Study on Aging. This is a large-scale, longitudinal survey of the South Korean population ages 45 and older residing in the community. The baseline survey instrument, modeled after the *Health and Retirement Survey*, included questions on demographics, family and social networks, health, employment and retirement, and income and assets (Lee, J., 2010).

The baseline data were collected from August to December of 2006. A stratified multi-stage probability sample was drawn from the 2005 Korean Census. The first stage was sampling stratified census enumeration districts by location, rural or urban residence, and housing type (i.e., apartment or single-family housing). The second stage of sampling randomly sampled households within selected enumeration districts. A total of 10,254 respondents completed the first-wave interview. Of these, 8,688 also completed the second-wave interview (187 of the original respondents died, and 1,379 did not complete it for other reasons).

There were 3,491 couples in the first wave. Of these, 2,997 were in the second wave (115 unions dissolved by death, 5 by divorce or separation, and attrition for unknown reasons occurred for 374 couples). Of these, 2,684 had complete data for depression and cognition questions; 259 couples had missing data due to proxy interviews and 54 couples had missing items.

Measures

We measured depression using the Korean version of the 10-item *Center for Epidemiologic Studies Depression* (CESD) scale. The CESD is based on self-reported items for depressive symptoms and was developed to identify high-risk individuals for epidemiological studies (Radloff, 1977). Its reliability and validity have been established for the Korean population (Jang, Kwag, & Chiriboga, 2010; Lee & Farran, 2004). The ten items ask respondents how

often they experienced symptoms in the past week. The items use a four-point Likert scale ranging from 0 to 3; the resulting CESD-10 scores range from 0 to 30, with higher scores representing more frequent depressive symptoms. In our sample, Cronbach's alpha was 0.76 in 2006 and 0.83 in 2008.

We measured cognitive ability using the Korean version of the Mini Mental State Exam (K-MMSE), a brief global instrument assessing the cognitive status of the elderly (Folstein et al., 1975) and validated for the Korean elderly population (Kang et al., 1997, Park & Kwon, 2004).The total K-MMSE score is calculated by summing the correct responses, ranging from 0 to 30, with higher scores representing better cognitive ability.

Covariates we control are age, education, chronic disease, and functional difficulties, which affect risks for both emotional and cognitive health (Bisschop et al., 2004; Carney et al., 2003; Turvey et al., 2009). We include age and age quadratic terms to capture possible non-linear effects. For education, we include a continuous variable of years of schooling. For chronic disease, we include binary variables on diabetes, hypertension, cancer, lung disease, heart problems, and stroke. We also include a binary variable for self-reported limitations in activities of daily living (ADLs) such as dressing, bathing, and eating (Nagi, 1976). We use a binary variable rather than a count for ADLs because ADLs are very rare, affecting only 2 percent of the study sample.

We also control for possible social influences on individual emotional and cognitive health by including binary variables for having a close friend, working, and participating in any organized social activities (e.g., attending church or social clubs, volunteering).

We control for couple-level characteristics by including family income and number of children in our analyses. For family income, we include a categorical variable of three equally-sized income terciles and a flag variable indicating missing values (51 couples for whom we imputed income; see the KLoSA User Guide, 2007, for details on imputation).

Statistical Methods

Descriptive analyses

We present separate univariate descriptive statistics for husbands and wives in 2006 and 2008. We weight the data and use robust standard error estimates to account for possible correlation among outcomes for individuals within census enumeration districts. We used similar procedures to derive descriptive statistics for differences among individuals in emotional and cognitive health from 2006 to 2008, including a cross-sectional weight for 2008 in order to reflect the surviving target population and account for sampling attrition. We also examine the Pearson correlation among outcomes for husbands and wives. For differences between husbands and wives, as well as differences for the same individual across time, we use an adjusted Wald test appropriate for survey data (StataCorp, 2009).

Multivariable analyses

To account for the dyadic nature of the data, we used a seemingly unrelated regression (SUR) model to predict MMSE and CESD scores in 2008 as a function of these scores in 2006. The estimated models are

$$M_{1,h,i}=\beta_{0\mathrm{Mh}}+\beta_{1\mathrm{Mh}}M_{0,h,i}+\beta_{2\mathrm{Mh}}C_{0,h,i}+\beta_{3\mathrm{Mh}}M_{0,w,i}+\beta_{4\mathrm{Mh}}C_{0,w,i}+\sum_{j=1}^{J}\alpha_{\mathrm{jMh}}z_{\mathrm{ji}}+\sum_{k=1}^{K}\gamma_{\mathrm{kMh}}x_{\mathrm{khi}}+\sum_{k=1}^{K}\phi_{\mathrm{kMw}}x_{\mathrm{kwi}}+e_{\mathrm{Mhi}}$$

$$C_{1,h,i}=\beta_{0\mathrm{Ch}}+\beta_{1\mathrm{Ch}}M_{0,h,i}+\beta_{2\mathrm{Ch}}C_{0,h,i}+\beta_{3\mathrm{Ch}}M_{0,w,i}+\beta_{4\mathrm{Ch}}C_{0,w,i}+\sum_{j=1}^{J}\alpha_{\mathrm{jCh}}z_{\mathrm{ji}}+\sum_{k=1}^{K}\gamma_{\mathrm{kCh}}x_{\mathrm{khi}}+\sum_{k=1}^{K}\phi_{\mathrm{kCw}}x_{\mathrm{kwi}}+e_{\mathrm{chi}}$$

$$M_{1,w,i}=\beta_{0\mathrm{Mw}}+\beta_{1\mathrm{Mw}}M_{0,w,i}+\beta_{2\mathrm{Mw}}C_{0,w,i}+\beta_{3\mathrm{Mw}}M_{0,h,i}+\beta_{4\mathrm{Mw}}C_{0,h,i}+\sum_{j=1}^{J}\alpha_{\mathrm{jMw}}z_{\mathrm{ji}}+\sum_{k=1}^{K}\gamma_{\mathrm{kMh}}x_{\mathrm{khi}}+\sum_{k=1}^{K}\phi_{\mathrm{kMw}}x_{\mathrm{kwi}}+e_{\mathrm{Mwi}}$$

$$C_{1,w,i}=\beta_{0\mathrm{Cw}}+\beta_{1\mathrm{Cw}}M_{0,w,i}+\beta_{2\mathrm{Cw}}C_{0,w,i}+\beta_{3\mathrm{Cw}}M_{0,h,i}+\beta_{4\mathrm{Cw}}C_{0,h,i}+\sum_{j=1}^{J}\alpha_{\mathrm{jCw}}z_{\mathrm{ji}}+\sum_{k=1}^{K}\gamma_{\mathrm{kCh}}x_{\mathrm{khi}}+\sum_{k=1}^{K}\phi_{\mathrm{kCw}}x_{\mathrm{kwi}}+e_{\mathrm{cwi}}$$

where $M_{t,h,i}$ is the MMSE score for a husband and $M_{t,w,i}$ that for a wife in couple i at time t (t=0 for 2006 and t=1 for 2008); $C_{t,h,i}$ represents the CESD score for a husband and $C_{t,w,i}$ that for a wife at time t in couple i; z_{ji} (j=1,…,J) represents couple-level characteristics (e.g., household income and number of children; J=2); and x_{khi} represents a husband's characteristics and x_{kwi} that for a wife for covariate k (k=1,…,K). The regression coefficients, $\beta_{3..}$ and $\beta_{4..}$, capture the effects of MMSE and CESD of one spouse in 2006 on these scores for the other spouse in 2008. E.g., $\beta_{3\mathrm{Mh}}$ and $\beta_{4\mathrm{Mh}}$ are the effects of a wife's MMSE and CESD scores in 2006 on her husband's MMSE score in 2008. Similarly, α_{jMh} represents the effect of couple-specific, γ_{kMh} the effect of husband-specific, and φ_{kMw} the effect of wife-specific covariates on the husband's MMSE in 2008.

To account for the non-independence of outcomes within couples and within individuals, we estimated these equations simultaneously using maximum likelihood estimation. The error terms for the four equations above, (e_{Mhi}, e_{Chi}, e_{Mwi}, e_{Cwi}), were assumed to be multivariately normally distributed with mean vector **0** and covariance matrix Σ, where the off-diagonals of Σ were to allowed to be non-zero to account for this non-independence. We estimated robust standard errors for regression coefficients to account for possible non-independence of persons sampled from the same census enumeration district. Finally, we graphically examined residuals to identify possible departures from the assumptions of

normality and heteroskedasticity and to examine how robust our inferences were to such violations.

We test hypothesis H1a, that poor emotional health is positively associated with cognitive decline in the subsequent period, by examining whether coefficients, β_{2Mh} and β_{2Mw}, are negative and statistically significant. We test hypothesis H1b, that poor cognition is positively associated with emotional distress in the subsequent period, by examining whether coefficients, β_{3Ch} and β_{3Cw}, are negative and statistically significant. We test hypothesis H2a, that emotional distress of one's spouse has a subsequent negative effect on one's own emotional health, by examining whether β_{4Ch} and β_{4Cw} are positive and statistically significant. We test hypothesis H2b, that cognitive impairment of one's spouse subsequently contributes to one's own cognitive impairment, by examining whether β_{3Mh} and β_{3Mw} are positive and statistically significant. We test hypotheses H3a, that emotional distress for one spouse leads to cognitive decline for the other, and H3b, that cognitive impairment for one spouse leads to emotional distress for the other, by examining whether β_{4Mh} and β_{4Mw} are negative and statistically significant.

We did not impute missing covariates for the very small proportion of couples (N=110; 3.67%) who had missing CESD or MMSE scores in 2006 due to proxy interviews or item-level non-response. Similarly, we did not impute MMSE and CESD scores missing in 2008 due to item non-response or proxy interviews (N=170; 5.67%) but rather these assumed these were missing at random (Little, 1992). We also omitted the small number of couples (N=33, 1.11%) who were omitted due to proxy interview status or non-response for MMSE or CES-D scores in both 2006 and 2008. We present unweighted regression results, including baseline covariates in the model to account for differences between persons included in the analysis and those excluded due to missing data (Gelman, 2007).

To further confirm that model estimates were not sensitive to attrition, we conducted sensitivity analyses using cross-sectional weights so that estimates reflected the target population in 2008. Because KLoSA does not supply a couple-level weight, we ran separate weighted analyses using the weight for each husband and wife. The correlation between these, 0.83, was very high, suggesting either weight should closely approximate a true couple-level weight.

Findings

Descriptive Findings

Table 1 shows depressive-symptom and cognitive-ability scores of husbands and wives in the balanced sample of 2,684 couples across both waves of the survey. Husbands were less likely to show depressive symptoms, having significantly lower CES-D scores than wives in both years. They also experienced a smaller, albeit statistically significant, increase in CES-D between years than wives. Husbands also exhibited greater cognitive abilities through significantly higher MMSE scores in both years. Scores for both husbands and wives decreased by a statistically significant amount between years, but did not change significantly more for husbands than wives.

Table 2 presents characteristics in 2006 of the balanced sample for husbands and wives regarding key risk contributors of depression and cognitive decline: age, education, chronic diseases, functional difficulties, labor market participation, and social activities. The mean age of the sample was 60 years (standard deviation or SD of 8.66) for husbands and 57 years (SD= 8.74) for wives. Husbands had a mean of 10 years of education while wives had a mean of 8 years.

Prevalence of chronic diseases and functional difficulties also differed between husbands and wives. Husbands tended to have a statistically significant and higher prevalence of at least one chronic disease (35%) compared to wives (32%). In particular, husbands reported statistically significant and higher prevalence of stroke, and diabetes. Men also have a statistically significant and higher prevalence of difficulty with at least one activity of daily living. No other difference between men and women in disease was statistically significant.

More husbands were in labor force than wives. Differences between husbands and wives in social participation and having a close friend were not statistically significant. Couples had on average three children and reported an average annual household income of about 33 million Korean Won (KW) (or about 33,000 U.S. dollars).

We also examined the correlation among CES-D and MMSE for husbands and wives in 2008. CESD and MMSE were negatively correlated for both husbands (corr=−0.3869) and wives (corr= −0.3618). Husband's CESD and wife's CESD were highly correlated (corr= 0.6179), as were the MMSEs for husband and wife (corr=0.5707). Husband's CESD and wife's MMSE had correlation −0.2731, and wife's CESD and husband's MMSE had correlation −0.2830.

Multivariable analyses

We fit an SUR model to the data. We then re-examined the correlations among outcomes after adjusting for individual and couple characteristics in the SUR model. This reduced the correlation between CESD and MMSE for husbands from −0.3869 to −0.2437 and for wives from −0.3618 to −0.1420. This also reduced the correlation between CESD for both spouses from 0.6179 to 0.5284 and between MMSE scores for husband and wife from 0.5707 to 0.3384. It reduced the correlation between husband's CESD score and wife's MMSE score from −0.2731 to −0.1078, and that between wife's CESD score and husband's MMSE's score from −0.2830 to −0.1021.

Table 3 presents full results of the SUR model. For husbands, we found domain-specific actor effects of CESD and MMSE. Not surprisingly, the CESD score in 2006 is a significant predictor of the CESD score in 2008, and the MMSE score in 2006 is a significant predictor of the MMSE score in 2008. Physical health problems contribute to mental health with stroke having negative effects on cognition and diabetes worsening emotional distress. Age has a curvilinear effect on cognition but is not significantly associated with emotional stress, where education has protective effects on both cognition and emotion. Finally, work is positively associated with emotional health. We find domain-specific spouse effects as well: wives' MMSE score in 2006 predicting the husband's MMSE score in 2008 and wives' CESD score in 2006 predicting the husband's CESD score in 2008. Wives' physical health,

particularly diabetes, has negative association with husband's MMSE. Although we find some statistically significant association between spouse's having cancer and heart disease with mental health, it is not clear why such pattern has been uncovered, calling for further study. We did not find any other spouse characteristics or shared environment to be associated with husbands' mental health.

For wives, we find similar domain-specific actor effects of CESD and MMSE. In addition, we find cross-domain actor effects of CESD and MMSE, which were not significant for husbands. We also find having heart disease, age and education are significantly associated with MMSE, and working status is significantly associated with CESD. It is interesting to note that social activities have positive effects on both MMSE and CESD for wives, while insignificant for husbands. Like husbands, we find significant domain-specific spouse effects: husbands' MMSE score in 2006 predicting the wives' MMSE score in 2008 and husbands' CESD score in 2006 predicting the wives' CESD score in 2008. We find husbands' heart disease has negative effect on wives' MMSE, and husbands' education is significantly associated with wives' CESD. We did not find any other spouse characteristics or shared environment to be associated with wives' mental health.

Table 4 shows the summary of hypotheses tests using the SUR model. To test hypothesis H1a, that individual emotional health subsequently affects individual cognitive decline, we test the direction and significance of coefficients for the CESD in 2006 for predicting the MMSE in 2008, controlling for MMSE in 2006. For husbands, the CESD score in 2006 was not a significant predictor of MMSE score in 2008. Nevertheless, for wives, a higher CESD score, indicating more depressive symptoms, was a statistically significant predictor of a lower MMSE score, indicating reduced cognitive abilities, in 2008 (coefficient = −0.0660).

We found similar results in our tests of hypothesis 1B on whether cognitive impairment subsequently affects emotional distress. Specifically, we find that for husbands, the MMSE score in 2006 was not a significant predictor of CESD score in 2008, whereas for wives, a lower MMSE score was a statistically significant predictor of a higher CESD score in 2008 (coefficient = −0.0852).

We find support for hypotheses 2a and 2b on within-domain spouse effects for both emotional and cognitive health. Specifically, for hypothesis 2a, we find that poor emotional health of one spouse predicts subsequent poor emotional health of the other. The coefficient (0.1954) for the effect of a wife's emotional health on her husband's was larger than that (0.0984) for the effect of a husband's emotional health on his wife's (Wald chi-squared test statistic (1df) = 4.17, p=0.0412).

Similarly, for hypothesis 2b, we find that poor cognitive health of one spouse predicts subsequent poor cognitive health for the other. The effect of wives cognitive health on their husbands (coefficient = 0.1009) was slightly higher than that of husbands on their wives (coefficient = 0.0689), but the difference between these coefficients was not statistically significant.

We did not find support for hypothesis 3a, which hypothesized emotional health of a spouse is associated with subsequent cognitive health of the respondent, nor for hypothesis 3b, that

cognitive health of a spouse is associated with subsequent emotional health of respondent. As shown in Table 3, the regression coefficients for these cross-domain spouse effects are statistically insignificant. That is, there is no evidence that emotional health of one spouse affects subsequent cognitive health of the other nor that cognitive health of one spouse affects subsequent emotional health of the other.

Discussion

The primary objective of this paper was to investigate longitudinal interrelations between emotional and cognitive health of couples. We took a dyadic approach and simultaneously examined (1) how respondent's emotional/cognitive health influences their own cognitive/emotional health in subsequent period (actor effects); (2) how cognitive/emotional health of one's spouse influences one's own subsequent cognitive/emotional health (within-domain spouse effects); and (3) how emotional/cognitive health of one's spouse influences one's own subsequent cognitive/emotional health (a cross-domain spouse effect).

Using panel data and CESD and MMSE measures for both husbands and wives, we examined changes in depressive symptoms and cognitive ability. Not surprisingly given the higher levels of educational attainment for men, husbands demonstrated better cognitive ability on the MMSE than wives. Our estimates of cognitive score are similar to those in other studies of Korean populations (Han et al., 2008; Park & Kwon, 2004). This is consistent with studies showing education accounts for most variation in cognitive functioning among older Koreans (Lee, 2011). Wives reported more depressive symptoms (higher CESD scores) than husbands, a finding that is also consistent with prior studies literature on gender differences in depression (Lee & Smith, 2011).

Previous literature had not determined whether there are gender differences in changes in cognitive ability and depressive symptoms for older adults. That is, it had not determined whether women or men have faster declines in emotional and cognitive health at advancing ages than the opposite gender. Over the two-year time period we examined, both husbands and wives experienced cognitive decline and worsened emotional health, but wives experienced a greater increase over time in depressive symptoms. Thus, as a couple aged, the difference in their emotional health widened. There was no statistically significant difference between the size of the change in MMSE score between husbands and wives, although our relatively young sample and availability of only two waves of data may limit our ability to observe large decreases in cognitive functioning.

Our analysis found asymmetric cross-domain effects for individuals. For men, emotional health did not have a statistically significant influence on cognitive health, nor did their cognitive health have a subsequent significant effect on emotional health. For women, poor emotional health had a significant and negative subsequent influence on cognitive health, just as cognitive ability had a significant subsequent effect on emotional health. Our findings support those of Gerstorf, Hoppmann, Kadlec, and McArdle (2009) on women's memory, but not men's, being affected by depression symptoms. They also support those of Peek et al. (2006) on cognitive functioning of wives, but not husbands, affecting depressive symptoms.

Considering that wives reported more initial depressive symptoms, experienced faster increases in depressive symptoms, and had lower cognitive functioning than husbands, we speculate that the asymmetric influence of emotional health on cognitive health, and that of cognitive health on emotional health, may become effective above certain thresholds, as Gerstorf, Hoppmann, Kadlec, and McArdle (2009) suggest, rather than being tied specifically to an individual's sex. These threshold effects may apply either to the absolute symptom score, or to a threshold in the change in depression or cognition. Further investigation using a longer panel could lead to a more definite conclusion about a threshold effect.

An alternative explanation could be that the biological pathway linking depression and cognition is different for men than for women. Differences in prevalence of individual symptoms measured in the CESD may reflect biological differences in how men and women respond to emotional stress. For some items, such as those about general affect ("How was your last week? Was it pretty good?") and life satisfaction ("How often do you feel you were satisfied overall?"), there was little difference between men and women in the sample. Nevertheless, there were large differences for concentration, energy, and sleep problems, all of which are more specifically tied to cognitive impairment than to general functioning and global assessments of well-being. Several studies linked this type of physiological response to cognitive impairment (Seeman et al., 1997; Karlamangla et al., 2005). Miller et al. (2002) further documented physiological differences in the brain between depressed men and women. Such physiological difference in neurological composition may influence emotional health and decline differently in women than in men. Thus, we might expect asymmetrical pathways by which depression affects cognition, and cognition effects depression, for women and men.

We observed statistically significant, though small, within-domain effects of spouses on each other. Controlling for educational attainment and the respondent's own cognitive and depressive symptoms as well as shared resources and environment, we find cognitive abilities for both husbands and wives predicts those of their spouse's. Similarly, we find the emotional health of one's spouse influences one's own subsequent emotional health after controlling for potential risk factors and shared resources and environment. The fact that such spouse effects persist after controlling for shared resources and environment suggest there are other pathways for them. Assortative mating can explain cross-sectional but not longitudinal effects.

Our findings appear to support explanations based in social interaction theory. Coyne (1976) first noted the change in response to a depressed person in a small study of college students. He suggested the propensity of depressed individuals to share intimate information about their troubles negatively affected the mood of those with whom they spoke. Such emotional contagion may be especially strong for spouses, who might be more likely share their thoughts or perceive depression in each other. Siegel et al. (2004) also observed that, controlling for educational attainment, changes in a spouse's CESD score predicts a respondent's CESD score. Similarly, cognitive contagion (Dufouil & Alpérovitch, 2000) can explain the longitudinal association between husbands and wives on cognitive abilities.

The effect of spouse's cognition is greater for husbands than wives. Our analysis also shows that wives' cognitive ability is lower than husbands', but found no statistical difference between spouses in cognitive decline. This differs from what Gerstorf, Hoppmann, Anstey, and Luszcz (2009) found among aging couples in Australia, where husbands' cognitive abilities subsequently affected that of their wives, but that of wives did not affect their husbands.. Gerstorf et al. attributed the difference in these effects to lack of variation over time in cognitive abilities for husbands. Yet lack of variation cannot explain our findings; we did not observe significantly higher variation in wives' cognition than husbands' in 2008 (the standard deviation on MMSE score for wives is 3.7; for husbands, the standard deviation is 3.6).

We also found that wives' emotional well-being is more likely to affect husbands than that of husbands is to affect wives. This supports some previous research findings but differs from others. Tower and Kasl (1996) as well as Gerstorf, Hoppmann, Kadlec, and McArdle (2009) find similar patterns. Tower and Kasl, examining multiple waves of U.S. longitudinal data, find husbands' CESD scores have less effect on those of their wives than wives' scores have on their husbands. They suggest men may feel responsible for their wives' well-being, and hence perceived changes in a wife's depression may have large effects on their husbands, particularly if wives are more emotionally expressive, and thus able to more effectively signal their emotions. Yet Peek et al. (2006) found depression of Mexican-American husbands had a subsequent significant effect on their wives, but that of wives did not affect their husbands. This contrast with our findings is perhaps made even more surprising by the the strict gender roles found in both Mexican-American and Korean cultures..

Previous research also found that spousal effects on depression and cognition are mediated by the degree of closeness in the marriage. The KLoSA does not have data on closeness of marriage so we were not able to investigate this. Since we use secondary data for analysis, omitted variables could bias our results. However, as many of these omitted variables are likely to be endogenous to emotional and cognitive health and marital status (Cho et al., 2008), making it is difficult to interpret even their measured effects.

The asymmetric patterns we observe in this work, and that Tower and Kasl as well as Gerstorf, Hoppmann, Kadlec, and McArdle observed in their work, may also be attributable to the large numbers of retirees in the research. Gerstorf, Hoppmann, Kadlec, and McArdle suggest gender roles are reshaped by retirement, particularly for males who move away from the workplace. Retirement is a drastic social transition, and without the social buffers of a structured work place, husbands may be more susceptible to contagion from their wives or more dependent on their wives as both partners orient themselves to new household roles (Gerstorf, Hoppmann, Kadlec, and McArdle, 2009).

We found no cross-domain spouse effects after adjusting for potential risk factors of cognitive and emotional health and accounting for correlations between husbands and wives using the SUR model. This contrasts with results of Gerstorf, Hoppmann, Anstey, and Luszcz, (2009), who found a wife's depression negatively affected her husband's subsequent memory, but that a husband's depression positively affected his wife's memory.

Our sample characteristics may explain why we do not observe cross-domain spouse effects. Our sample is relatively young, with the mean age of both husbands and wives less than 60 years; in both of Gerstorf's studies, the mean age of the sample is in the 70s. We only observe two points in time two years apart; this may affect our ability to observe significant changes in cognition and their effects, particularly if such changes occur more rapidly at older ages. Finally, we note differences in findings may be attributable to differences in outcome measures used to assess cognitive ability. Gerstorf and others rely on measures of memory, while we rely on the MMSE, a composite score of cognitive functioning, which also measures processing speed and executive functioning.

Conclusions

For older adults, emotion and cognition are closely interrelated, and therefore several researchers have recommended how research on how emotion and cognition may simultaneously affect each other (Hendrie et al., 2006; Steffens at al., 2006). In this paper, we examined the longitudinal association between emotional and cognitive health of older adults. Recognizing the importance of spousal influences on health (Gerstorf, Hoppmann, Anstey, and Luscz, 2009; Gerstorf, Hoppmann, Kadlec, and McArdle, 2009) and inter-spouse correlation on health measures (Meyler, Stimpson, & Peek, 2007), we further investigated how each spouse's emotional and cognitive health subsequently affects that of the other.

The Korean Longitudinal Study of Aging (KLoSA) provides panel data on both emotional and cognitive health of both spouses, allowing us to examine the longitudinal association between emotional and cognitive health for individuals and their spouses. Taking a dyadic approach, we fit a SUR regression model, estimating both individual actor-effects and spouse-effects in a subsequent wave. For individual effects, we find a significant impact of emotional health on cognitive health for wives, but did not find such a statistically significant effect for husbands. For spouse effects, we find strong evidence of domain-specific health concordance, supporting previous literature that spouses' health statuses are correlated. Our research also led to two new and interesting findings on how spouses influence their partner's health.

First, health concordance occurs only within domains and not across domains. Emotional health of one spouse influences that health of the other, but does not influence the other spouse's cognitive health. Likewise, cognitive health of one spouse influences cognitive health of the other spouse, even after controlling for educational attainment and other risk factors of cognitive decline.

Second, such within-domain spouse effects are much stronger for husbands than wives. Emotional health and cognitive ability of wives have stronger effects on emotional and cognitive health of husbands than that of husbands have on their wives'. What causes such differences in spouse effects is not clear, even after controlling for other potential social influences such as labor force participation, participating in organized social activities, and having a close friend. Further research may help explain gender differences in spouse effects.

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Table 1

Mean CESD and MMSE of Husbands and Wives(N=2684)

	CESD Husband			**Wife**			**CESD(H)-CESD(W)**		
	mean		**se**	**mean**		**se**	**Mean**		**se**
2006	5.356		0.104	5.865		0.113	−0.359	***	0.080
2008	5.960		0.142	6.855		0.148	−0.664	***	0.092
Difference = 2008–2006	0.625	***	0.130	0.992	***	0.130	−0.297	**	0.109
	MMSE Husband			Wife			MMSE(H)-MMSE(W)		
	mean		se	mean		se	Mean		se
2006	26.525		0.086	25.619		0.100	0.613	***	0.074
2008	26.087		0.094	25.356		0.102	0.439	***	0.069
Difference = 2008–2006	−0.453	***	0.075	−0.331	***	0.082	0.158		0.082

Note: Estimates are weighted and robust standard errors are calculated to account for design effects.

*
<.05;

**
<.01,

***
<.001

Table 2

Sample Characteristics: 2006 statistics (N=2684)

	Husband		Wife		Difference[1]
	Mean	SE	Mean	SE	
Age (years)	59.52	0.195	57.08	0.189	***
Years of school (years)	10.27	0.098	8.06	0.101	***
Has a chronic disease (%)	35.27%	0.010	32.25%	0.010	*
Heart problem (%)	4.21%	0.004	3.69%	0.004	
Stroke (%)	3.30%	0.004	2.14%	0.003	**
Diabetes (%)	12.06%	0.007	8.76%	0.005	***
Hypertension (%)	23.09%	0.009	24.12%	0.009	
Cancer (%)	2.08%	0.003	2.68%	0.003	
Has ADL handicap (%)	2.23%	0.003	1.41%	0.002	**
Currently working (%)	68.27%	0.010	36.87%	0.011	***
Has a close friend (%)	90.30%	0.010	90.76%	0.009	
Participates in social activity (%)	76.49%	0.012	74.73%	0.012	
Number of children (mean)[2]	2.8	0.028	2.9	0.03	NA
HH Income, 1,000 KW (mean)[2]	32934.0	3287.8	32514.8	4195.6	NA

* <.05;

** <.01,

*** <.001

Estimates are weighted using 2006 cross-sectional weights and robust standard errors are calculated to account for design effects in the sampling frame.

[1] Difference between a husband and a wife

[2] Couple-level measures are identical for the husband and wife of a couple. Differences in the means of the couple-level measures of number of children and household income are attributable to husbands and wives within each couple having different sampling weights – for example, men had a higher non-response rate than women.

Table 3

Results from a four-variable SUR model

	Husbands MMSE estimates	se	χ^2(df)		CESD estimates	se	χ^2(df)		Wives MMSE estimates	se	χ^2(df)		CESD estimates	se	χ^2(df)	
Actor effects																
CESD	−0.022	0.021			0.321	0.0230		***	−0.066	0.0200		***	0.381	0.0298		***
MMSE	0.388	0.032	***		−0.035	0.0369			0.435	0.0282		***	−0.085	0.0352		*
hypertension	−0.109	0.184			0.207	0.218			0.125	0.158			−0.330	0.224		
Diabetes	−0.243	0.230			0.825	0.277		**	0.010	0.255			0.283	0.365		
Cancer	−0.180	0.415			0.688	0.650			−0.356	0.308			0.795	0.581		
heart problem	0.030	0.358			0.640	0.452			−0.692	0.387		*	−0.115	0.521		
Stroke	−1.624	0.626		**	1.329	0.576		*	0.127	0.613			0.099	0.754		
adl binary	−1.318	0.720			1.276	0.690			−0.237	0.792			0.483	0.994		
age (df=2)			18.22	***			0.83				6.13	*			4.08	
age	5.003	1.480		**	−1.540	2.036			3.111	1.623			−1.782	2.538		
age^2	−0.452	0.123		***	0.135	0.164			−0.292	0.140		*	0.207	0.219		
education (years)	0.093	0.024		***	−0.079	0.032		*	0.104	0.027		***	−0.038	0.034		
working	0.112	0.132			−0.660	0.235		**	0.196	0.132			−0.602	0.201		**
close friend	0.256	0.334			−0.344	0.411			0.026	0.360			0.131	0.448		
social activity	0.126	0.196			−0.344	0.269			0.471	0.181		**	−0.796	0.265		**
Spouse effects																
CESD	−0.025	0.022			0.195	0.0284		***	0.028	0.0202			0.098	0.0310		**
MMSE	0.101	0.027		***	0.007	0.0324			0.069	0.0281		*	0.055	0.0391		
hypertension	0.018	0.168			−0.103	0.222			0.125	0.152			−0.330	0.225		
diabetes	0.453	0.231		*	0.543	0.370			0.010	0.188			0.283	0.263		
cancer	−0.873	0.427		*	0.358	0.609			−0.356	0.421			0.795	0.627		
heart problem	−0.192	0.394			−0.963	0.429		*	−0.692	0.337		*	−0.115	0.452		
stroke	−0.415	0.514			−0.089	0.672			0.127	0.417			0.099	0.578		
adl binary	1.333	0.770			−1.299	0.868			−0.237	0.574			0.483	0.665		
age (df=2)			1.90				0.08				3.49				1.73	
age	−2.288	1.663			0.581	2.258			1.072	1.461			−0.972	2.267		

		Husbands MMSE estimates	se	χ^2(df)		CESD estimates	se	χ^2(df)		Wives MMSE estimates	se	χ^2(df)		CESD estimates	se	χ^2(df)	
	age^2	0.200	0.145			−0.045	0.190			−0.112	0.121			0.046	0.186		
	education (years)	0.019	0.027			−0.030	0.037			0.044	0.023			−0.070	0.034		*
	working	−0.059	0.132			−0.339	0.204			−0.160	0.166			−0.306	0.201		
	close friend	0.000	0.327			0.319	0.474			0.117	0.329			0.164	0.400		
	social activity	0.292	0.187			−0.472	0.271			0.023	0.179			−0.214	0.285		
family effects																	
a	number of children	−0.003	0.070			−0.097	0.096			−0.128	0.069			0.056	0.091		
	Income (df=3)			2.82				1.57				1.99				1.79	
	low income	−0.067	0.210			−0.179	0.255			−0.039	0.201			0.174	0.254		
	high income	0.044	0.149			−0.064	0.222			−0.128	0.151			−0.177	0.217		
	missing income	−0.627	0.434			0.651	0.766			−0.602	0.460			0.272	0.768		
_constant		4.818	3.139			8.722	4.217		*	1.014	3.011			13.748	4.123		***
R-square		0.433				0.273				0.528				0.302			
N		2684				2684				2684				2684			

χ^2(df): chi-squared test statistic for the association of the categorical variable (with the degrees of freedom (df) of the test listed in the left column) with the outcome

*<.05;

**<.01,

***<.001

Table 4

Hypotheses testing: Parameter estimates from a four-variable SUR model (N=2684)

		Husbands								Wives						
		2008 MMSE				2008 CESD				2008 MMSE				2008 CESD		
		estimates	se			estimates	se			estimates	se			estimates	se	
Actor effects																
2006 CESD	H1a	−0.0224	0.0206			0.3213	0.0230	***	H1a	−0.0660	0.0200	***		0.3810	0.0298	***
2006 MMSE		0.3884	0.0323	***	H1b	−0.0353	0.0369			0.4347	0.0282	***	H1b	−0.0852	0.0352	*
Spouse effects																
2006 CESD	H3a	−0.0248	0.0215		H2a	0.1954	0.0284	***	H3a	0.0285	0.0202		H2a	0.0984	0.0310	**
2006 MMSE	H2b	0.1009	0.0265	***	H3b	0.0071	0.0324		H2b	0.0689	0.0281	*	H3b	0.0553	0.0391	

* <.05;

** <.01,

*** <.001