Trajectories of Cognitive Decline and Social Relations

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We assessed conjoint trajectories of cognitive decline and social relations over 7 years on a representative sample of community-dwelling elderly persons. We analyzed data using repeated measurement models. Social integration, family ties, and engagement with family were associated with cognitive function at advanced ages, controlling for education and introducing depressive symptoms, functional limitations, and chronic conditions as intervening variables. Association of social integration, through participation in community activities, with change in cognitive decline was more significant at advanced ages. Having friends was significantly associated with change in cognitive function in women only. Our findings have important implications for clinical medicine and public health because associations of social relations with cognitive function suggest that they may help to maintain cognitive function in old age.

Evidence from population studies suggests that social environments influence cognitive aging. Socioeconomic position during childhood and adolescence is a distal cause of cognitive decline and dementia (Alvarado, Zunzunegui, del Ser, & Béland, 2002; Ben-Shlomo, & Kuh, 2002; Hall, Gao, Unverzagt, & Hendrie, 2000; Moceri et al., 2001). Association between social relationships and the risk of dementia has been reported in Sweden (Fratiglioni, Wang, Ericson, Maytan, & Winblad, 2000). A case-control study in Germany showed a dose-response relationship between social ties and social activities in adults aged 30 years and vascular and Alzheimer-type dementia observed 10 years before the diagnosis (Seidler, Bernhardt, Nienhaus, & Fröhlich, 2003). These authors suggested that it may not be the presence of the tie but the engagement in the social interaction that has a protective effect on cognition.

Bassuk, Glass, and Berkman (1999) showed that social disengagement, an index of the diversity of close ties and social activities in the community, indicated a gradient effect on cognitive decline. Seeman, Albert, Lusuignolo, and Berkman (2001) focused on social support as a pathway with respect to the effects of social ties on health. After a 7-year follow-up, those with a high frequency of emotional support demonstrated better cognitive function. Neither the number of social ties nor group participation predicted cognitive decline in this population. The authors interpreted these results as evidence for the benefits of social interaction, but they were cautious in interpreting their surprising finding that negative relationships were also associated with better cognitive function.

As far as we know, no studies have estimated the associations of conjoint trajectories of social networks and social integration with cognitive decline through aging. Evidence for a long-term association of social relations trajectories with cognitive decline, even at very advanced ages, would be a significant step towards suggesting that population intervention efforts to promote social engagement of older subjects may reduce the size of the population at high risk due to social disengagement and may lower the incidence of dementia (Rose, 1985).

A second question that remains unanswered is the possible gender difference in the associations of social networks with cognitive function, or in the nature of social ties that are relevant to cognitive function for men and women (Taylor et al., 2000). Positive associations between social ties and engagement and maintenance of cognitive function were reported in a longitudinal study of older people in Spain, in which the nature of social relationships beneficial to cognitive function varied by gender (Zunzunegui, Alvarado, del Ser, & Otero, 2003).

The associations between social relationships and cognitive function may be mediated by cognitive effort. Studies have shown that productive and leisure activities are associated with a decreased risk of dementia and cognitive decline (Bosma et al., 2002; Crowe, Andel, Pedersen, Johannson, & Gatz, 2003; Richards, Hardy, & Wadsworth, 2003; Singh-Manoux, Richards, & Marmot, 2003). The Personnes âgées Quid (PAQUID) study showed that active participation in leisure activities (gardening, traveling, and knitting) predicted a lower risk of dementia, while group memberships and participation in social activities were not related to the incidence of dementia after 3 years of follow-up, when baseline cognitive performance was controlled (Fabrigoule et al., 1995). Leisure activities may demand more attention and control than social ties and social participation and generate a delaying effect on the dementia syndrome. Recent studies indicate that, in addition to the effects of leisure activities performed mainly in solitude, card playing, board games, and dancing also generate protective effects (Verghese et al., 2003; Wang, Karp, Winblad, & Fratiglioni, 2002).

Wang et al. (2002) stated that social ties may act through increased social support. Berkman, Glass, Brissette, and
Seeman (2000) cited pathways, other than social support, enabling social ties to influence health. Such pathways included healthy lifestyles, psychological factors, and physiological mechanisms, because stress may be neuro-degenerative, especially in the hippocampus, which plays a crucial role in the memory process (McEwen, 1998; O’Brien, Ames, & Schweitzer, 1993). Frequent social contacts and high rates of social integration and social engagement could dampen or moderate the effect of stress on the central nervous system; therefore, social relations may reduce brain damage and the effects of aging (Berkman et al.).

In this study, we explored conjoint trajectories over time of cognitive function and of social relations within the community, social ties, and social engagement with children, extended family, and friends, in a community-dwelling sample of people aged 65 and older. As in Singer and Willet (2003), we defined trajectories as descriptions of sequences of position of individuals on cognitive function and social relations through time. Our analysis strategy was based on the conceptual framework of Berkman and colleagues (2000). Briefly, they proposed the existence of a causal connection, mediated by upstream and downstream factors, between social networks and health. Upstream factors included distal mechanisms such as sociocultural conditions. Downstream factors included psychosocial mechanisms, for example, social support.

We defined social integration as community involvement such as belonging to neighborhood or religious groups or nongovernmental organizations and social networks by their structure (types and number of social ties, proximity of relationship) and function (frequency of contact, reciprocity, social engagement).

We examined two research questions: 1) Are trajectories in cognitive function associated with trajectories in social networks and social integration? 2) Do trajectories in cognitive function differ between men and women depending on the type of social relationship?

**METHODS**

**Participants**

The study Aging in Leganés (Envejecer en Leganés) was designed to assess the role of social networks and support in maintaining health and function within an aging Spanish population. The study population consisted of a stratified random sample ($n = 1,571$) of community-dwelling people aged 65 or older living in Leganés, a suburban municipality located 8 kilometers outside Madrid (Zunzunegui, BeLAND, & Gutierrez-Cuadra, 2001).

Response rate at baseline was 82% ($n = 1,272$). We collected baseline data in 1993 during two visits to respondents’ homes, first via a face-to-face interview and second via a medical exam. We collected follow-up data in 1995, 1997, and 1999. Respondent statuses are shown in Figure 1. People who missed one data collection were allowed to reenter the sample at future waves, resulting in 372 respondents participating over the four data collections and 346 fully participating until their deaths. In addition, 407 participated in three data collections, 224 participated in two, and 400 in one.

The number of questionnaires available with complete data on cognitive function was 1,165 in 1993, 910 in 1995, 765 in 1997, and 519 in 1999. The proportion of persons who moved out of Leganés ranged from 3.8% to 9.3% at follow-up, and refusals peaked at 18.9% in 1995. Death rates were 13% in 1995, 11% in 1997, and 17% in 1999.

At each follow-up, those who refused to participate at any one follow-up tended to have lower average cognitive function scores in 1993. However, those who refused to participate in
1997 or 1999 did not differ in cognitive scores in 1995, compared to those who participated; nor did those who refused in 1999 have lower cognitive function in 1997. Participants who died or were institutionalized had lower cognitive function than survivors or than those who lived in the community.

Measurements

Cognitive function.—We measured cognitive function using the Leganés' Cognitive Test (Prueba Cognitiva de Leganés, i.e., PCL). The PCL was designed to assess cognitive function in elderly people with a low level of education. It does not depend on the ability to read or write, nor does it contain any items requiring calculation, drawing, or abstract thinking. The PCL, with scores ranging from 0 to 32, has been validated to screen for dementia with a sensitivity of 93.9% and a specificity of 94.7% at the < 22 cut-off point. The intraclass correlation coefficient was 0.79 (0.74–0.83; García de Yébenes, Otero, Zunzunegui, & del Ser, 2003). The orientation index (0–8 points) includes time orientation (date, day of the week, time; range 0–3); place orientation (city and address; range 0–2); personal information (age, complete date of birth; month, day, and year); and mother’s name (range 0–3). The memory index (0–24 points) includes naming six common objects depicted in line drawings (range 0–6); immediate free recall of the six objects shown (range 0–6); delayed recall of the six objects 5 min later after completing several unrelated questions (range 0–6); and logical memory, that is, immediate free recall of a short story with six ideas (range 0–6). Zunzunegui, Gutierrez-Cuadra, Béland, del Ser, and Wolfson (2000) reported construct validity and internal consistency.

Social networks.—We used social ties and social engagement with significant others to measure social networks. We assessed social ties as follows: 1) we determined the number of relatives seen at least monthly to assess social ties with extended family; 2) we used a dichotomous indicator to indicate presence of friends, as only 48% reported having friends; 3) 93% of the respondents had children, and more than half lived with them; others lived within walking distance of their children’s homes and saw them at least weekly. Variations in social ties with children were low.

We assessed social engagement via three questions pertaining separately to children, extended family, and friends. We asked respondents how often they feel they help their children (family or friends); how often they feel useful to their children (family or friends); and how often they feel that they play an important role in their children’s (family’s or friends’) lives. We scored the items as follows: 2 (never), 1 (sometimes), 0.5 (frequently) and 2 (always). We assigned individuals without children, family, or friends a zero value for the corresponding variable. Factor analysis indicated the existence of a single factor for children, family, and friends respectively. The Cronbach’s alpha reliability coefficients were 0.64 for children, 0.68 for family, and 0.71 for friends. Cronbach’s Alpha of 0.70 or higher are acceptable for scales used in population studies. The alpha for the social engagement with children scale in this study was somewhat lower. Items were added to produce one score for children, one for family, and one for friends.

Social integration.—Four dichotomous markers of social integration were recorded: a) membership in a community association; b) at least monthly attendance of religious services; c) at least monthly attendance at a community center with recreational activities for seniors; and d) frequenting, at least monthly, a public square or outdoor meeting place. We compiled a social integration index by adding these indicators (score range = 0–4).

Upstream and downstream factors.—We entered gender and education (Schmand et al., 1997; White et al., 1994) as upstream factors according to Berkman’s (2000) social network and health model. Downstream factors included depressive symptoms, chronic conditions, and functional limitations (Bassuk, Berkman, & Wypij, 1998; Dufouil, Fuhrer, Dartigues, & Alperovitch, 1996; Holtzman et al., 2004; Zunzunegui, Béland, del Ser, & Gornemman, 1999). We measured depressive symptomatology (Cronbach’s alpha = –0.90) using the Spanish version of the Center for Epidemiology Studies—Depression Scale (CES-D; Moscicki, Locke, & Rae, 1989). Five chronic conditions were considered (hypertension, diabetes, stroke, Parkinson’s disease, and heart disease). Four questions assessed functional limitations of the upper and lower extremities (i.e., stooping or kneeling, reaching or extending arms, pulling or pushing large objects like chairs, handling or picking up small objects; Coroni-Huntley, Brock, Ostfeld, Taylor, & Wallace, 1986; Nage, 1976).

Statistical Analysis

We obtained four models. First, we used a growth model to estimate change in cognitive function. In this model, the slopes for age and age squared reflected what happens to cognition with each unit increase in age. Thus, we obtained rate of change in cognitive function with these slopes. This first model was not conditioned on other variables, as only age and age squared were entered. Second, we obtained conditional rates of change with the introduction of upstream and downstream factors into the model and through social relations measured at the same period as cognitive function. We examined our research questions in the third model using estimates of the associations between social relations and the conditional rate of change in cognitive function and, in the fourth model, via examination of the differences, in such associations, between men and women.

Rate of change in cognitive function.—To obtain a baseline growth model for rate of change in cognitive function, we regressed cognitive function on a quadratic function for respondents’ age using multilevel repeated measures models (Singer & Willett, 2003). As youngest respondents in the sample were aged 65, then this figure (65) was subtracted from age:

\[ Y_{ij} = \pi_0 + \pi_1(AGE_{ij} - 65) + \pi_2(AGE_{ij} - 65)^2 + \epsilon_{ij} \]

\[ \pi_0 = \gamma_{00} + \zeta_{0i} \]

\[ \pi_1 = \gamma_{10} + \zeta_{1i} \]

\[ \pi_2 = \gamma_{20} + \zeta_{2i} \]

Equation 1a defines variations of cognitive functioning over individuals and periods. \( Y_{ij} \) are observed cognitive scores for individual \( i \) at period \( j \), while prediction errors are the \( \epsilon_{ij} \). Thus,
predicators of cognitive function that can change through time have to be introduced at this level in the model. Equation 1b is the equation for average cognitive function over all periods for individuals aged 65, and Equations 1c and 1d are equations for rates of change. We defined average cognitive scores and rates of change at the level of the individuals \( i \). We introduced predictors constant over the period for each respondent into Equation 1b for main effects and into Equations 1c or 1d for interaction with \( AGE \) and \( AGE^2 \). In Equations 1b, 1c, and 1d, \( \gamma_0, \gamma_1, \gamma_2 \) are averages of the \( \pi_0, \pi_1, \) and \( \pi_2 \) over all respondents, and the \( \zeta_0, \zeta_1, \) and \( \zeta_2 \) are error terms.

In this model, and in all of the other models defined herewith, we defined only the intercept and slopes for age and for age squared as random. We defined all others as fixed.

**Conditional rate of change.**—In the next step (Model 2), we conditioned rates of change in cognitive function on upstream (education and gender) and downstream factors (depressive symptoms, chronic diseases, and functional limitations). Education and gender were constant over the period for each respondent; they were entered in Equation 2b. Downstream factors were time-varying variables; they could change at each period for each respondent. Thus, they had to be entered in Equation 2a. They have been put into brackets, with the intercept terms, to identify them more clearly. To simplify presentation of these variables in the equations, let us assume that \( DOWNSTREAM_{ij(k)} \), with \( k = 1–8 \), represents the eight measurements of downstream variables.

In this study, we tested social ties and social engagement in separate analyses because of colinearity between them. We introduced social integration in both of these analyses. We obtained estimates of the cross-sectional association of cognitive function with social integration, having friends, number of relatives seen monthly, and \( DOWNSTREAM_{ij(k)} \) with this set of equations:

\[
2a \quad Y_{ij} = \left[ \pi_{00} + \pi_{10} FRIENDS_{ij} + \pi_{20} RELATIVES_{ij} + \pi_{30} \text{INTEG}_{ij} + \sum_k \pi_{7(k)} DOWNSTREAM_{ij(k)} + \epsilon_{ij} \right] + \pi_{11}(AGE_{ij} - 65) + \pi_{12}(AGE_{ij} - 65)^2 \\
2b \quad \pi_{00} = \gamma_{00} + \gamma_{01} GENDER_{i} + \gamma_{02} EDUCATION_{i} + \zeta_{0i} \\
2c \quad \pi_{11} = \gamma_{10} + \zeta_{1i} \\
2d \quad \pi_{22} = \gamma_{20} + \zeta_{2i} \\
\]

**Rate of change, social ties, and social integration.**—The next model (Model 3) examines how social ties and social integration affect changes in cognitive function. We thus introduced these variables as interactions with \( AGE \) and \( AGE^2 \). We modified rates of change in cognitive function \( \pi_{10(m)} \) and \( \pi_{20(n)} \), where \( m \) refers to the main effect of age and its interaction with social ties indicators, and \( n \) refers to the main effect of age squared and their interactions with social ties. We used coefficients for these interactions to examine the first research question:

\[
3a \quad Y_{ij} = \left[ \pi_{00} + \pi_{10} FRIENDS_{ij} + \pi_{20} RELATIVES_{ij} + \pi_{30} \text{INTEG}_{ij} + \sum_k \pi_{7(k)} DOWNSTREAM_{ij(k)} + \epsilon_{ij} \right] + \pi_{11}(AGE_{ij} - 65) + \pi_{12}(AGE_{ij} - 65) FRIENDS_{ij} + \pi_{13}(AGE_{ij} - 65) RELATIVES_{ij} + \pi_{14}(AGE_{ij} - 65)^2 \text{INTEG}_{ij} \\
+ \pi_{21}(AGE_{ij} - 65)^2 + \pi_{22}(AGE_{ij} - 65)^2 FRIENDS_{ij} + \pi_{23}(AGE_{ij} - 65)^2 RELATIVES_{ij} + \pi_{24}(AGE_{ij} - 65)^2 \text{INTEG}_{ij} \\
3b \quad \pi_{00} = \gamma_{00} + \gamma_{01} GENDER_{i} + \gamma_{02} EDUCATION_{i} + \zeta_{0i} \\
3c \quad \pi_{10(m)} = \gamma_{10(m)} + \zeta_{10(m)} \quad m = 1 \ldots 4 \\
3d \quad \pi_{20(n)} = \gamma_{20(n)} + \zeta_{20(n)} \quad n = 1 \ldots 4 \\
\]

Lastly, in Model 4, we assessed differences between men and women with respect to the associations of social ties and social integration with cognitive function and rate of change in cognitive function by examining how gender interacted with social ties and social integration. To examine the second research question, we introduced gender into Equations 3c and 3d.

**Rate of change and social engagement.**—We examined rate of change in cognitive function using the same procedures and analytical procedures as for social ties. However, social engagement with children, relatives, or friends was only applicable to respondents with children, relatives, or friends. As suggested by McDonough and Walters (2001), a dummy variable for having children or friends was added to the equations, to obtain an estimate of the associations of rate of change in cognitive function with social engagement, controlling for having or not having children or friends. Only 8
respondents did not have relatives; we did not apply this procedure to social engagement with relatives.

Equations for social engagement were of the same general forms as equations for social ties, except for the introduction of social engagement with children, having friends, and having children to control for the presence or absence of friends and children in the model.

Lastly, as with social ties, we tested interactions of gender with social engagement and took into consideration dummy variables for the availability of children and friends. We conducted analyses with MLwiN, Version 2.0, software (Rasbash, Steele, Browne, & Prosser, 2004).

RESULTS

Sample Characteristics

At baseline, respondents’ average age was 76 (see Table 1); 58% were females, and 79% had not completed primary school. Chronic conditions and functional limitations were frequent. The average CES-D score was 11.5. Only 51% of respondents had friends, while the average number of family members seen monthly was 6.1. Out of a maximum of 4 activities, respondents participated in 1.2. Social engagement scores related to extended family were higher than those related to children and friends.

Table 2. Repeated Multivariate Analysis of Changes in Cognitive Function, Social Ties, and Social Integration

<table>
<thead>
<tr>
<th>Part</th>
<th>Model 1: Baseline Rate of Change in Cognitive Function</th>
<th>Model 2: Conditional Rate of Change in Cognitive Function</th>
<th>Model 3: Rate of Change With Social Ties</th>
<th>Model 4: Interactions With Gender</th>
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</table>

*Coefficients equal to or greater than twice their standard error.

aVariance and covariance terms associated with age² were uniformly zero.

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Cognitive Function

At baseline, the average cognitive function score was 23.9 (SD = 5.93). Averages and standard deviations remained stable over time (i.e., 23.0 (4.73) at T1; 25.2 (4.79) at T2; and 24.8 (6.81) at T3). The distribution of cognitive scores was skewed with a long tail to the left. We obtained the best approximation to normal distribution with a log-transform of the cognitive scores, subtracted from its maximum value (32) plus 1.

Baseline Rate of Change in Cognitive Function

Rate of change in cognitive function according to age was statistically significant, as shown in Table 2, Model 1 (see coefficients for age and age squared). For ease of interpretation, we plotted the association of estimated cognitive scores with age in Figure 2. We converted the log-transform dependent variable back into the original unit of measurement of the PLC cognitive function scale. As residuals from Model 1 in Table 2 were distributed normally, we did not use the correction for heteroscedasticity in the residuals suggested by Manning (1998). The line with triangles in Figure 2 represents estimated average cognitive scores. Each dotted line represents a regression curve for a specific respondent. Each curve begins at respondents’ age at baseline and represents respondents’ change in cognitive function over time as estimated by Model 1. Between respondents, estimated variation by age is represented vertically, while within respondents, regression curves were stable until age 75 and began to decline at an accelerated rate afterward. Also, the lower the cognitive score at baseline, the faster the decline over time.

Social Ties and Social Integration

Conditional rate of change.—Rate of change in cognitive function, as assessed via age squared, increased and remained statistically significant with the introduction of downstream and upstream factors and with the cross-sectional associations of social ties and social integration with cognitive status. (Table 2, Model 2).

Association with rate of change.—Rate of change in cognitive function was associated with social integration only (Table 2, Model 3). In Figure 3, we plotted the association of age with the estimated cognitive function obtained from Model 3 for respondents with high and low levels of social integration. At high levels of social integration, cognitive function remained stable over time, while with low levels of social integration, cognitive function declined at an accelerating rate as participants aged.

Gender differences in rate of change.—Interactions between gender and social ties and social integration indicated that...
having friends was associated with a slower decline in cognitive function for women (Table 2, Model 4 and Figure 4). For men, this interaction was not statistically significant. The interaction of age with family ties reached statistical significance in Model 4. Respondents with more family ties experienced less cognitive decline until about 80 years of age.

Social Engagement and Social Integration

Conditional rate of change.—Rates of change in cognitive function decreased by half with the introduction of upstream and downstream factors and social engagement. Nonetheless, the coefficient for age squared remained statistically significant (Table 3, Model 2).

Association with rate of change.—Only engagement with family was significantly associated with rate of change in cognitive function (Table 3, Model 3). Figure 5 shows that engagement with family delayed the decline in cognitive functioning up until age 95.

Gender differences in rate of change.—There were no statistically significant differences between men and women in any of the social engagement variables (Table 3, Model 4).

**DISCUSSION**

Our results with respect to the two research questions examined in this article are as follows:

1. Family ties and social engagement with relatives and social integration were associated with rate of change in cognitive function. Conjoint trajectories of social relations and cognitive function were complex. Respondents with higher levels of family ties and social engagement with relatives maintained better cognitive function up until 80 years of age than respondents with low levels. After 80, the difference diminished. The association between social integration and rate of change in cognitive function appeared when the association with engagement with relatives waned, that is, after 75 years old.

2. Having friends was shown to be associated with rate of change in cognitive function for women.

3. Changes in cognitive function followed different patterns with different types of social relationships: a) An increasing difference in cognitive functioning with aging between those with high and low levels of social integration; b) a better cognitive functioning for women with friends, compared to those without, that was maintained over time; c) and, finally, with aging, a loss of the advantage obtained for those with high social engagement with family, compared to those without.
Our findings are compatible with previous work (Bassuk et al., 1999; Borenstein Graves et al., 2001; Seeman et al., 2001; Zunzunegui et al., 2003). They provide evidence of the importance of social relations in old age, demonstrating that social integration in the community and having friends are relevant to cognition, even at very advanced ages, and that family contacts are beneficial, in particular when these contacts are enhanced with an added sense of engagement through perceived usefulness to relatives. Our results also show that the associations of social relations with cognitive functioning may depend on the type of relationship. As Seidler and colleagues (2003) demonstrated, we found that social engagement and social integration appear to be more important than social ties.

To interpret these results, the social context of the elderly population in Spain, which is typical of Mediterranean societies, must be taken into account. The social life of the current generation of elderly people in Spain is centered on the family, while friends play a lesser role. For this age cohort, there has been a marked separation of social roles by gender; women's social role was restricted to domestic life while men's role was centered on kinship. However, our results show that for women, having friends was related to rate of change in cognitive function over time. Thus, it appears that women's ability to maintain friendships throughout the life course, in a society where their social role confined them within the household, helped them to maintain their cognitive ability and may have postponed its decline. The association of friendships with cognitive function in Spanish women requires further study. These results are consistent with studies demonstrating gender-specific associations between social relations and health for men and women (Berkman & Syme, 1979; Fuhrer, Standsfeld, Chemali, & Shipley, 1999; Glass, Mendes de Leon, Seeman, & Berkman, 1999; Moritz, Kasl, & Berkman, 1995; Unger, McAvay, Bruce, Berkman, & Seeman, 1999).

Measures relying on self-reported engagement could be confounded by mental decline (Glass et al., 1997). We found that participants with low cognitive scores at baseline tended to either die or move out of the study area (Alvarado et al., 2002). To examine the effect of mortality and attrition on our results, we tested a multivariate model with “deceased” entered as the dummy dependent variable at each follow-up. Associations between cognitive status, age, and mortality were modeled in the error variance-covariance matrix. The estimated value of the regression coefficient for age squared was cut by half but remained highly significant. Thus, higher mortality rates in those with low cognitive scores do not appear to account for our results.

The small sample size of our original cohort and losses to follow-up limit the accuracy of our estimates. In addition, the study of third-order interactions (social relationships–gender–age) lacks statistical power. Also, we measured social relations and cognitive function simultaneously at each of the four data
collections. Though there was a clear declining trend in cognitive function over time, we identified conjoint trajectories of cognitive function and social relations through time. These trajectories do not imply a causal relation between them, and our findings must be interpreted cautiously with respect to causality.

In conclusion, maintaining social relations in old age may be beneficial for maintaining cognitive functioning. However, the pattern of associations of social relations with cognitive function differed by social relationship, indicating that these potential benefits may depend on the types of social relationship and on gender. Further studies are needed on this topic to identify the pathways through which these effects are playing out. For example, social relations may be beneficial via mechanisms other than cognitive effort, such as fostering a sense of mastery and competence regarding previous social roles.

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Holzman, R. E., Rebok, G. W., Saczynski, J. S., Kouzis, A. C., Wilcox Figure 5. Association of age with cognitive function by family engagement.


