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SOCIAL ENGAGEMENT AND COGNITIVE FUNCTION IN OLD AGE

Kristin R. Krueger

Rush Alzheimer's Disease Center and Department of Behavioral Sciences, Rush University Medical Center, Chicago, Illinois, USA

Robert S. Wilson and Julia M. Kamenetsky

Rush Alzheimer's Disease Center and Departments of Neurological Sciences and Behavioral Sciences, Rush University Medical Center, Chicago, Illinois, USA

Lisa L. Barnes,

Rush Alzheimer's Disease Center, Rush University Medical Center, Chicago, Illinois, USA

Julia L. Bienias, and

Rush Institute for Healthy Aging and Department of Internal Medicine, Rush University Medical Center, Chicago, Illinois, USA

David A. Bennett

Rush Alzheimer's Disease Center and Department of Neurological Sciences, Rush University Medical Center, Chicago, Illinois, USA

Abstract

We examined the association of diverse measures of social engagement with level of function in multiple cognitive domains in 838 persons without dementia who had a mean age of 80.2 (SD = 7.5). Social network size, frequency of social activity, and level of perceived social support were assessed in linear regression models adjusted for age, sex, education, and other covariates. Social activity and social support were related to better cognitive function, whereas social network size was not strongly related to global cognition. The results confirm that higher level of social engagement in old age is associated with better cognitive function but the association varies across domains of social engagement.

Social engagement refers to maintenance of social connections and participation in social activities (Bassuk, Glass, & Berkman, 1999). Recent research suggests that older people who are more socially engaged tend to have a higher level of cognitive function (Barnes, Mendes de Leon, Wilson, Bienias, & Evans, 2004; Bassuk et al., 1999; Holtzman et al., 2004; Yeh & Liu, 2003; Zunzunegui, Alvarado, del Ser, & Otero, 2003) compared to less engaged persons. With few exceptions (Barnes et al., 2004), these studies have not assessed nonsocial experiences such as cognitive activity and physical activity that have also been associated with level of cognitive function (Dustman, Emmerson, & Shearer, 1994; Wilson et al., 1999) and rate of cognitive decline (Weuve et al., 2004; Wilson, Mendes de Leon, et al., 2002). Thus, the

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Address correspondence to Kristin R. Krueger, 600 S. Paulina Street, Suite 1038, Chicago, IL 60612. kris2blink@yahoo.com.

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extent to which the association of social engagement with cognitive function reflects other lifestyle factors has not been extensively investigated. In addition, knowledge about the bases of these associations remains limited. One reason for this uncertainty is that both social engagement and cognitive function are multidimensional constructs but have often been assessed with brief unidimensional measures.

In the present study, we examined the relation of social engagement to level of cognitive function in older persons from the Rush Memory and Aging Project, a clinical-pathologic study of risk factors for common chronic conditions of old age. We used three measures of social engagement: social network size, frequency of participation in social activities, and perceived level of social support. Cognition was assessed with a battery of 19 performance tests administered in an approximately 1-h session. Based in part on a factor analysis of the tests at baseline, composite measures of episodic memory, semantic memory, working memory, processing speed, and visuospatial ability were derived (Wilson et al., 2002). By constructing these composite measures, we were able to examine the association of social engagement with multiple cognitive domains. In analyses, we tested whether higher levels of each indicator of social engagement was associated with higher level of cognition, whether these associations varied across cognitive domains, and whether other affective, lifestyle, and health-related variables could account for these associations.

METHODS

Participants

Persons participating in this study are from the Rush Memory and Aging Project, a prospective clinical-pathologic study of risk factors for common chronic conditions of old age (Bennett et al., 2005). They were primarily recruited from subsidized housing facilities and continuous care retirement communities in the Chicago metropolitan area. Following a presentation about the study, individuals rated their interest in participation, and those who expressed interest were subsequently contacted by project personnel who provided more detailed information and obtained informed consent. The study was approved by the Institutional Review Board of Rush University Medical Center.

Upon enrollment in the project, all participants underwent a uniform clinical evaluation, which included a self-report medical history, cognitive function testing by trained neuropsychological technicians, and a complete neurological examination by trained nurses. On the basis of this examination and an in-person evaluation of the participant, an experienced clinician (neurologist, geriatrician, or geriatric nurse practitioner) classified each person with respect to dementia, using the criteria of the joint working group of the National Institute of Neurologic and Communicative Disorders and Stroke and the Alzheimer's Disease and Related Disorders Association (McKhann et al., 1984).

Between September 1997 and July 2006, 3397 persons attended presentations about the study and 2231 indicated that they were 'very' or 'somewhat' interested in participating. By July 2006, 1102 of those expressing interest had enrolled and completed baseline evaluation. Of these participants, 197 had missing social variable data and were excluded. We excluded an additional 67 people who met criteria for dementia, leaving 838 persons eligible for analyses. They had a mean age of 80.2 ($SD = 7.5$), a mean of 14.4 years of formal schooling ($SD = 3.0$), a mean score of 27.9 ($SD = 2.1$) on the Mini-Mental State Examination, and 75% were women and 91% were white and non-Hispanic.

Assessment of Social Engagement

Social engagement was assessed with measures of social activity frequency, size of social networks, and perceived social support. Frequency of social activity was assessed by asking how often during the past year participants engaged in six common types of activities that involve social interaction (1: go to restaurants, sporting events, or teletrack, or play bingo; 2: go on day trips or overnight trips; 3: do unpaid community/volunteer work; 4: visit relatives' or friends' houses; 5: participate in groups, such as senior center, VFW, Knights of Columbus, Rosary Society, or something similar; 6: attend church or religious services; Mendes de Leon, Glass, & Berkman, 2003). Persons rated each activity on a 5-point scale, with 5 indicating participation in the activity every day or nearly every day, 4 indicating participation several times a week, 3 for several times a month, 2 for several times a year, and 1 for once a year or less. Item responses were summed and averaged to yield a total score. In prior research in this cohort, higher scores on this measure have been associated with higher levels of socioeconomic status (Wilson, Scherr, Schneider, Tang, & Bennett, 2007) and psychosocial functioning (Barnes et al., 2007).

We quantified social network size with standard questions (Cornoni-Huntley, Brock, Ostfeld, Taylor, & Wallace, 1986) about the number of children, family, and friends each participant had and how often they had seen them. Social network size was the number of these individuals seen at least once per month, as previously described (Barnes et al., 2004).

Social support was assessed with four questions (items 1, 2, 5, 10) from the Multidimensional Scale of Perceived Social Support (Zimet, Dahlem, Zimet, & Farley, 1988). These four items (e.g., "There is a special person who is around when I am in need") make up the Significant Other subscale of the questionnaire, as established in factor analytic studies (Cheng & Chan, 2004; Zimet, Powell, Farley, Werkman, & Berkoff, 1990). Participants rated agreement with each statement on a 5-point scale, and item scores were averaged so that the total score ranged from 1 to 5, with higher scores denoting more social support.

Assessment of Cognitive Function

Cognitive function was assessed with a battery of 19 performance tests. The Mini-Mental State Examination (Folstein, Folstein & McHugh, 1975) was used for descriptive purposes but not in analyses. The 19 performance tests were used in analyses. There were seven episodic memory measures: Word List Memory, Recall, and Recognition (Morris et al., 1989) and immediate and delayed recall of Story A from Logical Memory of the Wechsler Memory Scale–Revised (Wechsler, 1987) and of the East Boston Story (Albert et al., 1991; Wilson, Beckett, et al., 2002). Semantic memory was assessed with a 15-item version (Morris et al., 1989) of the Boston Naming Test (Kaplan, Goodglass, & Weintraub, 1983), Verbal Fluency (Morris et al., 1989; Wilson, Beckett, et al., 2002), and a 15-item version (Wilson, Beckett, et al., 2002) of the National Adult Reading Test (Nelson, 1982). Working memory tests included Digit Span Forward and Digit Span Backward (Wechsler, 1987) and digit ordering (Cooper & Sagar, 1993; Wilson, Beckett, et al., 2002). Four measures of perceptual speed were administered: the oral version of the Symbol Digit Modalities Test (Smith, 1982), Number Comparison (Ekstrom, French, Harman, & Kermen, 1976; Wilson, Beckett, et al., 2002), and two measures from a modified version (Wilson et al., 2005) of the Stroop Neuropsychological Screening Test (Trenerry, Crosson, DeBoe, & Leber, 1989): number of color names correctly read in 30s minus the number of errors and number of colors correctly named in 30s minus the number of errors. Visuospatial ability was assessed with a 15-item version of Judgment of Line Orientation (Benton, Sivan, Hamsher, Varney, & Spreen, 1994) and a 16-item version of Standard Progressive Matrices (Raven, Court, & Raven, 1992).

To minimize floor and ceiling artifacts and other sources of measurement error, composite measures of two or more individual tests were used in analyses. Based in part on a previous factor analysis (Wilson et al., 2005), summary measures of episodic memory (seven tests), semantic memory (three tests), working memory (three tests), perceptual speed (four tests), and visuospatial ability (two tests) were formed along with a measure of global cognition based on all 19 tests. In each case, individual tests were converted to z scores, using the mean and standard deviation from the entire cohort, and then the z scores were averaged to yield the composite measure. Further information about the individual tests and the derivation of these composite measures is published elsewhere (Wilson, Barnes, et al., 2003; Wilson et al., 2005).

Assessment of Other Covariates

Depressive symptomatology was assessed with a 10-item version (Kohout, Berkman, Evans, & Cornoni-Huntley, 1993) of the Center for Epidemiologic Studies Depression Scale (Radloff, 1977). Persons were asked if they had experienced each of 10 symptoms (e.g., "I felt sad") much of the time during the past week. The score was the number of symptoms experienced. Scores on this scale have been shown to correspond well with scores on the original version of the scale (Kohout et al., 1993) and to predict dementia (Wilson, Barnes, et al., 2002; Wilson, Mendes de Leon, Bennett, Bienias, & Evans, 2004) and mortality (Wilson, Bienias, Mendes de Leon, Evans, & Bennett, 2003) in old age.

The personality traits of neuroticism, indicative of distress proneness, and extraversion, indicative of sociability, were measured with 6-item versions of the standard 12-item scale of each trait from the NEO Five-Factor Inventory (Costa & McCrae, 1992). Persons rated agreement with each neuroticism item (item numbers 1, 6, 21, 36, 41, 51; e.g., "I often feel inferior to others") and each extraversion item (item numbers 2, 7, 17, 27, 37, 52; e.g., "I like to have a lot of people around me") on a 5-point scale. Item scores ranged from 0 to 4, with higher scores denoting a higher level of the trait. Item scores were summed and multiplied by two to make the total scores (range: 0 to 48) more comparable to the standard 12-item scales. In a separate group of 932 older persons without dementia from the Rush Religious Orders Study (Wilson, Bienias, Evans, & Bennett, 2004), the 6-item neuroticism measure had a correlation of 0.90 with the standard 12-item scale, and the 6-item extraversion measure had a correlation of 0.91 with the standard 12-item scale, supporting the validity of the brief measures.

Persons rated their current frequency of participation in nine cognitively stimulating activities (e.g., reading a book, visiting a library) on a 5-point scale, with 5 indicating participation in the activity every day or about every day and 1 indicating participation once a year or less. We focused on common activities in which seeking or processing information was central and which had minimal social or physical demands. Item scores were averaged to yield a summary measure of cognitive activity that has been shown to have adequate short-term temporal stability and positive associations with education and cognitive ability (Barnes, Wilson, Mendes de Leon, & Bennett, 2006; Wilson, Barnes, & Bennett, 2003; Wilson et al., 2005).

Frequency of physical activity was assessed with questions adapted (McPhillips, Pellettera, Barrett-Connor, Wingard, & Criqui, 1989) from the 1985 Health Interview Survey (1985 Health Interview Survey, 1985). Persons were asked if they had participated in each of five activities (e.g., walking for exercise, calisthenics) during the past 2 weeks, and if so, the number of times and mean time per occasion. Minutes in each activity were summed and divided by 120 to yield a summary measure of hours per week of physical activity, as described elsewhere (Wilson, Mendes de Leon, et al., 2002).

The presence of seven chronic medical conditions was determined from medical history (i.e., diabetes, hypertension, heart disease, cancer, thyroid disease, head injury) or from history plus examination (i.e., stroke). The number of conditions present was used as a measure of chronic illness, as described elsewhere (Wilson, Mendes de Leon et al., 2002; Wilson, Beckett, Bienias, Evans, & Bennett, 2003).

Disability was assessed with the Katz scale (Katz, Ford, Moskowitz, Jackson, & Jaffe, 1963). Participants indicated whether they could independently perform each of six daily living activities: walking, bathing, dressing, eating, getting from bed to chair, and toileting. The score was the number of activities that the person was unable to perform independently.

Data Analysis

We examined the association of three measures of social engagement with global cognition in a series of linear regression analyses, controlling for age, sex, and education. We initially entered each measure of social engagement separately and then entered the three measures together. Subsequent analyses added terms for depressive symptoms, neuroticism, and extraversion; for cognitive and physical activities; or for chronic illness and disability. We then repeated this set of analyses separately for measures of specific cognitive domains in lieu of the measure of global cognition. All models were validated graphically and analytically. Programming was done in SAS (SAS Institute Inc., 2000).

RESULTS

Distribution of Social Engagement Measures

Social activity scores ranged from 1 to 4.2 (mean = 2.6, $SD = 0.6$), with higher scores indicating more activity. Social activity was inversely related to age, neuroticism, and disability and positively related to education, extraversion, and cognitive and physical activities (Table 1). Social network size ranged from 0 to 66 persons seen at least monthly (mean 6.9, $SD = 5.8$). Social support ranged from 1 to 5 (mean = 4.3, $SD = 0.7$), with higher scores indicating more support. Social network size and social support were positively related to each other and social activity, and they had similar patterns of correlations with other covariates (Table 1), consistent with the idea that they are each facets of a broader construct such as social engagement.

Social Engagement and Global Cognitive Function

We examined the relation of social engagement to level of global cognition by entering the three social engagement indicators separately and then together in linear regression models. These models and all subsequent analyses controlled for the potentially confounding effects of age, sex, and education. When the indicators were entered separately, both social activity and social support had a positive association with global cognition: estimate (unstandardized beta weight) for social activity = 0.173, $SE = 0.029$, $p < .001$, 3% increment in adjusted R^2 compared to a model with only demographic variables; and social support = 0.087, $SE = 0.023$, $p < .001$, 1% increment in R^2 . Social network was not associated with global cognition: social network = 0.005, $SE = 0.003$, $p = 0.73$. With all three social variables entered simultaneously, results were not substantially changed: estimate for social activity 0.161, $SE = 0.029$, $p < .001$; estimate for social support = 0.069, $SE = 0.023$, $p = .003$; estimate for social network = .000, $SE = 0.003$, $p = .882$; 4% increment in R^2 . In subsequent analyses, therefore, we entered social activity and social support simultaneously and dropped social network.

Because social engagement is associated with depression and personality, we repeated the analysis controlling for depressive symptomatology and for the personality traits of neuroticism and extraversion (Table 2, model B). In this analysis, the associations of social activity and social support with global cognition were reduced by about 25%, but remained significant.

Because cognitive and physical activities are related to social engagement and cognition, we repeated the initial model with terms added for cognitive activity score and physical activity score (Table 2, model C). Compared to the initial analysis, the effect for social activity was reduced by about 60% but remained significant, and the effect for social support was reduced by less than 25%, and remained significant.

To see if poor health could account for the relation of social engagement to global cognition, we repeated the initial model with terms added for number of chronic medical conditions and for level of disability on the Katz scale (Table 2, model D). The results of this analysis were comparable to the initial analysis.

Social Engagement and Function in Specific Cognitive Domains

To determine whether social engagement was related to some forms of cognition and not others, we repeated the analyses with each of the five summary measures of specific cognitive domains as outcomes in place of the measure of global cognition. Frequency of social activity was positively related to level of function in each cognitive domain in the initial analyses (Table 2, model A). Adjustment for depressive symptomatology and personality (Table 2, model B) or for chronic illness and disability (Table 2, model D) did not substantially affect results. Conversely, controlling for cognitive and physical activities (Table 2, model C) substantially reduced the association between social activity and cognition in all domains except for episodic memory, which was reduced by about 15% but remained significant.

In the initial analysis (Table 2, model A), social support was positively related to level of function in working memory, perceptual speed, and visuospatial ability, but not in episodic or semantic memory. Results were comparable after adjusting for depressive symptoms and personality, cognitive and physical activities, and chronic illness and disability.

DISCUSSION

We examined the relation of multiple indicators of social engagement to level of cognitive function in more than 800 older persons without clinical signs of dementia. More frequent participation in social activities and a higher level of perceived social support were associated with higher level of cognitive functioning.

Higher levels of social activity and social integration have been associated with better cognitive functioning in prior research (Barnes et al., 2004; Bassuk et al., 1999; Zunzunegui et al., 2003), as in the present study. In two studies that did not observe the association, social activity assessment was based on activity during a single day in one (Hilleras, Jorm, Herlitz, & Winblad, 1999) and on three dichotomous items in the other (Aarsten, Smits, van Tilburg, Knipscheer, & Deeg, 2002), suggesting that some of the inconsistency in previous research may be due to variability in how social activity=social integration was defined and how adequately it was assessed.

Previous studies have found a positive association between perceived social support and global cognitive function in older people (Holtzman et al., 2004; Lee & Shinkai, 2005; Yeh & Liu, 2003), consistent with the present results. Controlling for chronic illness and disability had no effect on the relation of social support to cognition in the present study. By contrast, adjustment for depression and personality and for cognitive and physical activities reduced the association by approximately 25% (from an estimate of 0.068 in the original model to 0.050 and 0.052, respectively). This reduction suggests that affect and activity lifestyle may partially account for the relation of perceived social support to cognition.

Social network size was not related to cognitive function in this cohort, though there was a nearly significant correlation in initial analyses without other measures of social engagement in the model. Larger network size has been associated with higher level of cognitive function in some previous studies (Barnes et al., 2004; Holtzman et al., 2004), but evidence has been weak (Zunzunegui et al., 2003) or mixed in others (Arbuckle, Gold, Andes, Schwartzman, & Chaikelson, 1992). These results suggest that social network size is not strongly related to level of cognitive function in old age. It may be that satisfaction with social relationships within one's network is more important than number of social contacts (Fratiglioni, Wang, Ericsson, Maytan, & Winblad, 2000).

The basis of the association between these diverse indicators of social engagement and cognitive function is uncertain. Frequency of cognitive (Wilson et al., 1999, 2005) and physical (Dustman et al., 1994) activities is also positively related to cognitive function in older persons. In this study, the modest association of social activity with global cognitive function was reduced by over 50% when we controlled for cognitive and physical activities, but remained significant. This suggests that social activities also involve some degree of cognitive and physical activities, consistent with prior research (Christensen & MacKinnon, 1993), and also account for a unique, albeit small, portion of the variance in cognition. We found little evidence that depression, personality, or chronic illness could account for the relation of social engagement indicators with cognitive function.

A novel feature of this study is that we examined the association of social engagement with function in different domains of cognition. More frequent social activity was related to better function in multiple domains of cognition. In contrast, a consistent effect of social support was observed for only three domains: working memory, perceptual speed, and visuospatial ability. This finding was unexpected. It suggests that having supportive relationships has more to do with problem-solving abilities and processing efficiency than with storage of information.

This study has several strengths. A relatively large number of participants was studied so that there was adequate power to observe the associations of interest even after controlling for selected covariates. We used previously established composite measures of different cognitive domains, reducing measurement error and permitting examination of selective associations of social engagement with cognition. Finally, we used multiple indicators of social engagement given the multidimensional nature of this construct.

The study has important limitations as well. Analyses are based on a selected group of participants so that it will be important to determine whether the results generalize to defined populations of older people. In addition, the findings are cross-sectional. Longitudinal studies will be needed to elucidate the direction of the association between social engagement and cognition.

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Table 1

Correlations of social engagement measures with each other and covariates*

	Range	Mean	SD	Social network	Social support	Age	Education	CES-D	Neuroticism	Extraversion	Cognitive activity	Physical activity	Chronic illness	Disability
Social activity	1–4.2	2.56	.59	.26	.17	–.17	.17	–.06	–.16	.31	.45	.15	–.01	–.18
Social network	0–66	6.62	5.85	–	.20	–.08	.01	–.08	–.10	.23	.10	.09	.00	–.02
Social support	1–5	4.31	.71	–	–	–.13	.06	–.17	–.19	.29	.15	.00	.03	–.07
Age	54–100	80.16	7.51			–	–.04	.01	.04	–.11	–.10	–.06	–.01	.05
Education	3–28	14.37	3.00				–	–.23	–.26	.04	.36	.06	–.02	–.05
CES-D	0–10	1.34	1.80					–	.51	–.19	–.17	–.08	.08	.12
Neuroticism	0–44	15.56	7.21						–	–.29	–.20	–.05	–.00	.09
Extraversion	14–48	31.39	5.97							–	.16	.13	–.01	–.06
Cognitive activity	1–4.67	3.16	.68								–	.12	–.04	–.15
Physical activity	0–35	3.04	3.64									–	–.02	–.07
Chronic illness	0–6	1.44	1.07										–	.05
Disability	0–5	.196	.64											–

* $p < .01$ for correlations with an absolute value of .09 or more.

Table 2

Relation of social engagement to global cognitive function and specific cognitive domains*

Outcome	Model term	Model A		Model B		Model C		Model D	
		Estimate (SE)	p value	Estimate (SE)	p value	Estimate (SE)	p value	Estimate (SE)	p value
Global cognition	Social activity	.160 (.030)	<.001	.152 (.030)	<.001	.069 (.030)	.022	.147 (.029)	<.001
	Social support	.068 (.023)	.003	.050 (.024)	.034	.052 (.022)	.019	.066 (.023)	.004
Episodic memory	Social activity	.177 (.038)	<.001	.164 (.040)	<.001	.125 (.041)	<.003	.171 (.039)	<.001
	Social support	.023 (.030)	.444	.005 (.032)	.881	.013 (.030)	.678	.020 (.030)	.510
Semantic memory	Social activity	.117 (.036)	.001	.104 (.037)	.005	-.026 (.037)	.491	.107 (.037)	.004
	Social support	.055 (.029)	.056	.037 (.030)	.211	.034 (.027)	.212	.055 (.029)	.058
Working memory	Social activity	.099 (.045)	.027	.102 (.046)	.027	.049 (.048)	.310	.087 (.045)	.055
	Social support	.107 (.036)	.003	.094 (.037)	.011	.094 (.035)	.008	.105 (.036)	.003
Perception speed	Social activity	.273 (.044)	<.001	.263 (.045)	<.001	.084 (.045)	.061	.251 (.044)	<.001
	Social support	.117 (.035)	<.001	.089 (.036)	.014	.089 (.033)	.007	.114 (.035)	.001
Visuospatial ability	Social activity	.092 (.045)	.040	.102 (.046)	.027	.026 (.048)	.586	.074 (.045)	.101
	Social support	.089 (.036)	.012	.079 (.037)	.030	.076 (.035)	.031	.089 (.035)	.012

* Estimated from linear regression models adjusted for age, sex, and education. In addition, model B adjusted for depressive symptoms and personality, model C for cognitive and physical activity, and model D for chronic illness and disability. The estimates are unstandardized beta weights.