

## Association between a Change in Social Interaction and Dementia among Elderly People

著者別名	安梅 勅江, 新井 哲明
journal or publication title	International Journal of Gerontology
volume	10
number	2
page range	76-80
year	2016-06
権利	(C) 2016, Taiwan Society of Geriatric Emergency & Critical Care Medicine. Published by Elsevier Taiwan LLC. This is an open access article under the CC BY-NC-ND license ( <a href="http://creativecommons.org/licenses/by-nc-nd/4.0/">http://creativecommons.org/licenses/by-nc-nd/4.0/</a> ).
URL	<a href="http://hdl.handle.net/2241/00143617">http://hdl.handle.net/2241/00143617</a>

doi: 10.1016/j.ijge.2016.03.006



## Original Article

Association between a Change in Social Interaction and Dementia among Elderly People<sup>☆</sup>Cunyoen Kim<sup>1</sup>, Bailiang Wu<sup>1</sup>, Emiko Tanaka<sup>1</sup>, Taeko Watanabe<sup>2</sup>, Kumi Watanabe<sup>1</sup>, Wencan Chen<sup>1</sup>, Sumio Ito<sup>3</sup>, Rika Okumura<sup>3</sup>, Tetsuaki Arai<sup>1</sup>, Tokie Anme<sup>1\*</sup><sup>1</sup> Graduate School of Comprehensive Human Sciences, University of Tsukuba, Tsukuba, Ibaraki, <sup>2</sup> Japan University of Health Sciences, Saitte, Saitama, <sup>3</sup> Department of public welfare, Tobisima, Aichi, Japan

## ARTICLE INFO

## Article history:

Received 25 October 2015  
Received in revised form  
30 December 2015  
Accepted 2 March 2016  
Available online 7 June 2016

## Keywords:

dementia,  
elderly,  
longitudinal study,  
social interaction

## SUMMARY

**Background:** Since limited, specific assessments of social environments have previously been used, with the effect of a change in social interaction proving rare in previous studies, this study sought to clarify the specific association between changes in social interaction and symptoms of dementia.**Methods:** The participants were elderly people, aged > 60 years, from a suburban community. All the participants formed part of the investigation from 2008 to 2011. The Index of Social Interaction was used to measure social interaction among elderly people. Data of dementia were obtained from Health and Welfare Center of local government. The chi-square test and a logistical regression analysis were used to examine the relationship between changes in social interaction and dementia.**Results:** There were 321 participants without missing data. The results showed that “reading newspapers” was a positive change in social interaction in relation to the risk of dementia (odds ratio = 3.45, confidence interval: 1.04–11.45).**Conclusion:** This study focused on changes in social interaction and found that a positive change could help prevent dementia. Specifically, this study indicated that elderly people’s engagement with the social environment and in intellectual activities would prevent dementia.Copyright © 2016, Taiwan Society of Geriatric Emergency & Critical Care Medicine. Published by Elsevier Taiwan LLC. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

## 1. Introduction

Since health is defined as a state of complete physical, mental, and social well-being<sup>1</sup>, successful aging is given greater consideration on “health and disease” or “physical, mental, and social activity.”<sup>2</sup> Besides avoidance of disease and disability, successful aging includes maintenance of high physical and valid cognitive function, productive activities, and engagements with social interaction<sup>3</sup>. Prevention of cognitive decline is very important for successful aging<sup>4</sup>. However, elderly people’s cognitive function declines with advancing age; this is a pervasive issue in gerontology<sup>5</sup>.

In order to prevent dementia, by delaying a decline in cognitive function, it is necessary to study the environmental factors related to dementia. For example, Suzuki<sup>6</sup> pointed out that cognitive function among humans does not just decline with advancing age,

but can also be improved by their experiences in environmental contexts. Moreover, Park and Bischof<sup>7</sup> demonstrated that engagements in environments that require sustained cognitive efforts may facilitate cognitive function. Hertzog et al<sup>8</sup> found that environmental contexts can enhance the development of cognitive function for humans both in adulthood and in old age.

Generally, the environment refers to external aspects that involve individuals<sup>9</sup>. The social environment can be defined as an individual’s social background and culture<sup>10</sup>. Importantly, human beings tend to set their targets, with expectations for the future, so as to change their external environment according to their desires, rather than, through sheer motivation, being assimilated into the external environment. Therefore, humans can actively create and modify their developmental environments, based on their targets<sup>6</sup>. In social environments, this interaction is considered social interaction and can be rated in terms of both qualitative and quantitative aspects, such as the frequency of interaction with one’s family or community<sup>10</sup>.

As mentioned above, environmental stimuli are beneficial for the prevention of dementia. For example, Zunzunegui et al<sup>11</sup> found that a decline in elderly people’s cognitive function could be predicted by poor social interactions, infrequent participation in social

<sup>☆</sup> Conflicts of interest: All contributing authors declare that they have no conflicts of interest.

\* Correspondence to: Professor Tokie Anme, Graduate School of Comprehensive Human Sciences, University of Tsukuba, 1-1-1 Tennodai, Tsukuba, Ibaraki, 305-8577, Japan.

E-mail address: [tokieanme@gmail.com](mailto:tokieanme@gmail.com) (T. Anme).

activities, and social disengagement. In their review, Fratiglioni et al.<sup>12</sup> found that social engagement, social activities, and physical exercise can improve cognitive function among elderly people. These studies implied that the stimuli within social interactions might contribute toward the prevention of dementia.

Although social interaction has been proved as an important factor of dementia prevention, several issues need to be studied further. First, there are a few studies using specific assessments to measure social interaction; therefore, specific correlates of social interaction are not clear. Second, a few studies have focused on the effect of a change in social interaction on the prevention of dementia.

Thus, this study sought to clarify the specific association between changes in social interaction and symptoms of dementia.

## 2. Materials and methods

### 2.1. Design

This was a 3-year, longitudinal prospective cohort study using data from a project implemented in a suburban area, named “Community empowerment and care for well-being and healthy longevity: evidence from a cohort study (CEC)<sup>13</sup>.” The “CEC” commenced in 1991, and all the residents participated in this investigation every 3 years.

### 2.2. Participants

In the baseline year (2008), 1176 elderly people without dementia participated in the study. Between the period 2008 and 2011, 153 participants were excluded due to relocation and death. Therefore, there were 1023 participants until 2011. To facilitate analysis of complete data only, 702 individuals with missing data were eliminated. Ultimately, 321 elderly people were retained in the analysis, and the response rate was 31.4%.

### 2.3. Items of investigation

In this study, the investigation consisted of three distinct parts. Social interaction was evaluated through the Index of Social Interaction (ISI), which was developed to enable evaluation of different types of social interactions among Japanese people. The ISI contains five subscales and 18 items (Appendix 1). The Cronbach  $\alpha$  for the subscales ranged from 0.78 to 0.81; previous studies also demonstrated the measure's validity and reliability<sup>10</sup>. The score on each item was determined through the frequency indicated on the items, and a higher score indicated a higher frequency.

Data of dementia were obtained from Health and Welfare Center of local government. Dementia was determined through a clinical diagnosis by medical doctors and examination by professionals. If participants were diagnosed to “have dementia” or “have symptoms of dementia,” they were classified as the “dementia group.” Else, they belonged to the “normal group.”

Participants were required to indicate their age, gender, and disease status. With regard to disease status related to the question “were you hospitalized within the past year or do you have any diseases that must be treated for more than 2 weeks continually?”, participants were classified into the “disease group” or “no-disease group,” based on their answers (i.e., “yes” or “no”).

### 2.4. Data analysis

The chi-square test and multiple logistical regression analysis were used to examine the relationship between a change in social interaction and the status of dementia.

The independent variable was the change in social interaction. The change in social interaction was considered a “negative change” if the score on the item during the baseline year was higher than that in the following year; else, the change was considered a “positive change.”

The dependent variable was dementia status. Based on diagnoses, the participants were classified as the “dementia group” and the “normal group.”

Age (60–74 years old = 0, older than 75 years = 1), gender (male = 0, female = 1), and disease status (no = 0, yes = 1) were analyzed as control variables since these might have an influence on daily living abilities and dementia.

All procedures of analysis were conducted using the SAS 9.3, and  $p < 0.05$  was the accepted significance level for all statistical results.

### 2.5. Ethical considerations

All participants agreed to sign an informed consent form and were made aware that they had the right to withdraw from this study after being notified of its objective and processes. Additionally, the data were collected anonymously, and a personal identification system was used to maintain the confidentiality of the participants' personal information. This study was implemented after being approved by the ethics committee of the University of Tsukuba.

## 3. Results

### 3.1. Demographics on background and dementia status

Table 1 depicts the characteristics of 321 participants, and the associations between the characteristics and dementia. With regard to age, of the participants with symptoms of dementia, 22 (8.5%) were in the 60–74-year-old group and 16 (25.4%) in the group aged > 75 years. The chi-square results revealed a significant association between age and symptoms of dementia ( $\chi^2 = 13.80$ ,  $p < 0.001$ ). In addition, there were no significant results with regard to gender, diseases, and dementia.

### 3.2. ISI and dementia status

Table 2 shows the chi-square results for a change in the ISI and symptoms of dementia from 2008 to 2011. For items of the social curiosity subscale, the chi-square results regarding dementia symptoms and a change relating to “reading newspapers” were significant ( $\chi^2 = 5.10$ ,  $p = 0.02$ ).

### 3.3. Multidimensional analysis for the ISI and dementia status

After controlling for age, gender, and diseases, multiple logistic regression analysis was performed to predict symptoms of dementia 3 years after the change relating to ISI items. As shown in Table 3, the change in “reading newspapers” was significantly related to symptoms of dementia after 3 years (odds ratio = 3.45).

## 4. Discussion

This study focused on changes in social interaction and found that a positive change in this regard could help prevent dementia. Although previous studies have pointed out the importance of social interaction in cognitive function, the results of this study further suggested that continuous enrichment of social interaction is also necessary for cognitive functioning among elderly people. Notably, situations comprising social interaction among elderly people were measured through a specific mode of assessment

**Table 1**  
Association between characteristics and dementia.

Item	Category	Dementia (2011)				N = 321		
		Yes		No		n	$\chi^2$	p
		n	%	n	%			
Age (2008)	60–74 y	22	8.5	236	91.5	258	13.807	<0.001
	Older than 74 y	16	25.4	47	74.6	63		
Gender (2008)	Male	19	11.7	144	88.3	163	0.011	0.919
	Female	19	12.0	139	88.0	158		
Diseases (2008)	No	16	11.7	121	88.3	137	0.006	0.939
	Yes	22	12.0	162	88.0	184		

during the baseline year and the year thereafter. Therefore, this follow-up study presented a comprehensive picture of the manner in which specific social interactions changed and how those changes affected elderly people's dementia status.

In this study, a significant association was found between age and symptoms of dementia. Recent previous studies have demonstrated that cognitive function declines with age<sup>14</sup>, and that aging is a critical factor affecting cognitive functioning among elderly people and apparent, early cognitive impairment could ultimately result in dementia<sup>15</sup>. This study also supported the view that aging is closely associated with dementia status. In addition, since the

majority of previous studies on development in late adulthood also focused on cognitive function among individuals in their 60s and beyond<sup>16</sup>, this study might provide more evidence for examining age as an important correlate of dementia.

With regard to the gender of participants, Gatz et al<sup>17</sup> found a relationship between symptoms of dementia and gender, especially in advanced old age. The majority of the participants were in early old age; however, the effect of gender might not be apparent at the early stages of old age. Thus, more attention should be paid to gender, as aging progresses.

Previous studies have shown that certain diseases are related to functional status<sup>18,19</sup>; likewise, some chronic diseases, such as diabetes, hypertension, and cardiovascular diseases, were found to be important risk factors for dementia<sup>20</sup>. Despite the statistical insignificance of the result relating to the role played by disease prevention in dementia status in this study, disease prevention might contribute toward the prevention of dementia.

In this study, a change in social interaction was positively inclined (maintenance or improvement). This study showed that the majority of the participants had positive social interaction, and suggested that social interaction among older adults could be maintained or improved through efforts to interact with social environments, even though aging is inevitable.

**Table 2**  
Association between a change in social interaction and dementia.

Item	Change	Dementia (2011)						N = 321	
		Yes		No		Total	$\chi^2$	p*	
		n	%	n	%				
Independence									
Being motivated to live	PC	28	13.2	184	86.8	212	1.122	0.290	
	NC	10	9.2	99	90.8	109			
Taking an active approach	PC	32	14.6	188	85.5	220	4.911	0.027	
	NC	6	5.9	95	94.1	101			
Being motivated to live a healthy live	PC	29	12.9	196	87.1	225	0.796	0.372	
	NC	9	9.4	87	90.6	96			
Having regular lifestyle	PC	30	13.0	201	87.0	231	1.042	0.307	
	NC	8	8.9	82	91.1	90			
Social curiosity									
Reading newspapers	PC	33	10.8	273	89.2	306	5.097	0.024	
	NC	5	33.3	10	66.7	15			
Reading books	PC	30	12.0	220	88.0	250	0.028	0.866	
	NC	8	11.3	63	19.6	71			
Trying to use new equipment	PC	29	14.2	175	85.8	204	3.032	0.082	
	NC	9	7.7	108	92.3	117			
Having a hobby	PC	25	13.0	116	89.9	192	0.641	0.424	
	NC	13	10.1	167	87.0	129			
Feeling of importance	PC	50	13.9	311	86.2	361	4.214	0.040	
	NC	51	20.1	203	60.5	254			
Interaction									
Communicating within family	PC	31	11.1	249	88.9	280	1.125	0.289	
	NC	7	17.1	34	82.9	41			
Communicating with nonfamily persons	PC	28	11.5	216	88.5	244	0.128	0.720	
	NC	10	13.0	67	87.0	77			
Interacting with nonfamily persons	PC	24	12.2	172	87.8	196	0.080	0.778	
	NC	14	11.2	111	88.8	125			
Participation in the society									
Participating in social groups	PC	25	11.9	186	88.2	211	0.000	0.994	
	NC	13	11.8	97	88.2	110			
Participating in neighborhood affairs	PC	31	13.6	197	86.4	228	2.332	0.120	
	NC	7	7.5	86	92.5	93			
Watching television	PC	37	11.9	275	88.1	312	0.005	0.945	
	NC	1	11.1	8	88.9	9			
Having an active role in society	PC	32	12.4	226	87.6	258	0.402	0.526	
	NC	6	9.5	57	90.5	63			
Feeling of safety									
Having counsel	PC	30	11.5	232	88.6	262	0.205	0.651	
	NC	8	13.6	51	86.4	59			
Having someone to give support in emergency	PC	35	12.9	236	87.1	271	1.934	0.164	
	NC	3	6.0	47	94.0	50			

\* p value: chi-square test.

NC = negative change; PC = positive change.

**Table 3**  
Multiple logistic results for dementia.

Variables	OR	95% CI	N = 321	
			p	
Reading newspapers	3.45	1.04	11.45	0.035
Age	0.29	0.14	0.60	0.001
Gender	1.15	0.56	2.34	0.707
Diseases	0.90	0.44	1.85	0.775

Multiple logistic analysis.  
 Reading newspapers: contrast = positive change.  
 Age: contrast = 60–74 y.  
 Gender: contrast = male.  
 Diseases: contrast = no diseases.  
 Control variables: age, gender, and diseases.

CI = confidence interval; OR = odds ratio.

Many previous studies have demonstrated an association between social interaction and functional capacity among older individuals. For example, Kawachi and Berkman<sup>21</sup> surmised that social interaction has a positive influence on mental health. In their study, Bassuk et al<sup>22</sup> and Gleib et al<sup>23</sup> concluded that social disengagement is a risk factor for cognitive impairment among elderly people. Seeman<sup>24</sup> reviewed studies focused on social environments and concluded that connection with family, friends, and neighbors, or engaging in social activities could contribute toward cognitive function. Furthermore, a review of previous studies on dementia also concluded that leisure activity was significantly associated with dementia, and that mental and physical activities could protect against cognitive decline and dementia<sup>12,25</sup>.

The results of the 3-year longitudinal study revealed that advanced intellectual activity, such as “reading newspapers,” played a significant role in the decline of dementia symptoms. Although developments in society are associated with changes in the use of social media, especially information technology, newspapers are still a primary mode of accessing social information for older people<sup>26</sup>. Therefore, “reading newspapers” is not only an intellectual activity, but also a way of interacting with the social environment. This result corresponded with those of previous studies and suggested the importance of social interaction, including intellectual activities.

However, one point should be mentioned. This study revealed an adverse result for the item “taking an active approach.” It means that the proportion of dementia within the positive-change group, whose members subscribed to “taking an active approach,” was larger than that within the negative-change group. A possible statistical reason for this result is that the number of elderly people in the positive-change group was much larger than that in the negative-change group.

There were three originalities in this study. First, this was a longitudinal study focusing on a change in social interaction, rather than on a temporary social interaction situation. Thus, the results could enrich evidence supporting the association between social interaction and dementia. Second, the measurement of social interaction was multidimensional; this provided rich stimulation from the environment and represented the dynamic nature of older people’s daily lives. The study examined particular associations between social interaction and dementia.

Limitations of this study should also be mentioned. First, only one suburban area was investigated. Second, the decline in the response rate was inevitable. Therefore, the deficiency of the data may potentially bias the study and limit the generalization of the findings in this study. In addition, more confounding factors that can affect cognitive function with social interaction should be considered in further studies.

In conclusion, this study focused on changes in social interaction and found that a positive change in this regard may help prevent dementia. This study also showed that elderly people’s active and consistent engagement in social and intellectual activities would effectively prevent dementia.

**Acknowledgments**

We are deeply grateful to Mr Kuno (Mayor of Tobishima), Mr Hattori (Deputy Mayor), and all the research participants and staff. This research was supported by the Grants-in-Aid for Scientific Research (26590107, 26285130).

**Appendix 1. Index of Social Interaction.**

<b>1. Independence</b>		
Motivation to live	“Do you have motivation to live an active lifestyle?”	(1) Always (2) often (3) sometimes (4) rare
Taking an active approach	“Do you take an active approach toward your life?”	(1) Always (2) often (3) sometimes (4) rare
Being motivated to live a healthy life	“Are you motivated to live a healthy life?”	(1) Always (2) often (3) sometimes (4) rare
Having regular lifestyle	“Do you have a regular or routine lifestyle?”	(1) Always (2) often (3) sometimes (4) rare
<b>2. Social curiosity</b>		
Reading newspapers	“Do you read newspapers regularly?”	(1) Every day (2) twice a week (3) once a week (4) rare
Reading books	“Do you read books or magazines regularly?”	(1) Every day (2) twice a week (3) once a week (4) rare
Try to use new equipment	“Do you try to use new equipment like a video?”	(1) Always (2) often (3) sometimes (4) rare
Having a hobby	“Do you have any hobby?”	(1) Always (2) often (3) sometimes (4) rare
Feeling of importance	“Do you have feeling of importance in the society?”	(1) Always (2) often (3) sometimes (4) rare
<b>3. Interaction</b>		
Communication within the family	“Do you often communicate with your family members?”	(1) Every day (2) twice a week (3) once a week (4) rare
Communication with non-family persons	“Do you communicate with nonfamily persons regularly?”	(1) Every day (2) twice a week (3) once a week (4) rare
Interaction with nonfamily persons	“Do you interact with nonfamily persons regularly?”	(1) Every day (2) twice a week (3) once a week (4) rare
<b>4. Participation in the society</b>		
Participation in social groups	“Do you have chance to participate in social groups?”	(1) Every day (2) twice a week (3) once a week (4) rare
Watching television	“Do you watch television?”	(1) Every day (2) twice a week (3) once a week (4) rare
Participation in neighborhood affairs	“Do you have chance to participate in your neighborhood affairs?”	(1) Always (2) often (3) sometimes (4) rare
Having an active role in society	“Do you have an active role in the society or social affairs?”	(1) Always (2) often (3) sometimes (4) rare
<b>5. Feeling of safety</b>		
Having counsel	“Do you have someone to counsel with in difficult situation?”	(1) Always (2) often (3) sometimes (4) rare
Having someone to give support in emergency	“Do you have someone to support you in emergency?”	(1) Always (2) often (3) sometimes (4) rare

## References

- World Health Organization. *WHO Definition of Health*. New York, NY: WHO; 1946. Available at: <http://www.who.int/about/definition/en/print.html> [Accessed October 25, 2015].
- Tate RB, Lah L, Cuddy TE. Definition of successful aging by elderly Canadian males: the Manitoba Follow-up Study. *Gerontologist*. 2003;43:735–744.
- Rowe JW, Kahn RL. Successful aging and disease prevention. *Adv Ren Replace Ther*. 2000;7:70–77.
- Kawashima Y. *Social Interaction as Preventive Interventions of Dementia for Community-Dwelling Elderly*. Master thesis. Tsukuba, Japan: University of Tsukuba; 2010.
- Feldman H, Gauthier S, Hecker J, et al. Efficacy of donepezil on maintenance of activities of daily living in patients with moderate to severe Alzheimer's disease and the effect on caregiver burden. *J Am Geriatr Soc*. 2003;51:737–744.
- Suzuki T. *Keikenyakunrenwa Chinowodoukaeruka, Syougaihattatsuno dainamikusu-Chino tayouseiyikikatanokasei*. 1st ed. Tokyo: University of Tokyo; 2008 [In Japanese].
- Park DC, Bischof GN. The aging mind: neuroplasticity in response to cognitive training. *Dialogues Clin Neurosci*. 2013;15:109–119.
- Hertzog C, Kramer AF, Wilson RS, et al. Enrichment effects on adult cognitive development: can the functional capacity of older adults be preserved and enhanced? *Psychol Sci Public Interest*. 2008;9:1–65.
- Kouno Y. *Seyikatsukankyono gainento ronten*. In: Kimura T, ed. *Seyikatsukankyoron*. 5th ed. Tokyo: Ishiyaku; 2007:2–3 [In Japanese].
- Anne T, Shimada C. Social interaction and mortality in a five year longitudinal study of the elderly. *Jpn J Public Health*. 2000;47:127–133.
- Zunzunegui M, Alvarado BE, Del Ser T, et al. Social networks, social integration, and social engagement determine cognitive decline in community-dwelling Spanish older adults. *J Gerontol B Psychol Sci Soc Sci*. 2003;58:93–100.
- Fratiglioni L, Paillard-Borg S, Winblad B. An active and socially integrated lifestyle in late life might protect against dementia. *Lancet Neurol*. 2004;3:343–353.
- Tokie Anne. Community empowerment and care for well-being and healthy longevity: evidence from cohort study (abbr. CEC). Available at: <http://plaza.umin.ac.jp/~empower/cec/index-e.html>. [Accessed December 20, 2015].
- Ardiles AO, Tapia-Rojas CC, Mandal M, et al. Postsynaptic dysfunction is associated with spatial and object recognition memory loss in a natural model of Alzheimer's disease. *Proc Natl Acad Sci U S A*. 2012;109:13835–13840.
- Sampedro-Piquero P, Bartolo PD, Petrosini L, et al. Astrocytic plasticity as a possible mediator of the cognitive improvements after environmental enrichment in aged rats. *Neurobiol Learn Mem*. 2014;114:16–25.
- Bialystok E, Craik IMF. Structure and process in life-span cognitive development. In: Overton WF, ed. *The Handbook of Life-Span Development*. 2nd ed. New Jersey: JW&S; 2010:195–197.
- Gatz M, Fiske A, Reynolds CA, et al. Sex differences in genetic risk for dementia. *Behav Genet*. 2003;33:95–105.
- Smyth A, Glynn LG, Murphy AW, et al. Mild chronic kidney disease and functional impairment in community-dwelling older adults. *Age Ageing*. 2013;42:488–494.
- James S, Recharad CM, Mosen A. Relationship of disease severity to decline on specific cognitive and functional measures in Alzheimer disease. *Alzheimer Dis Assoc Disord*. 1998;12:146–151.
- Lin PJ, Yang Z, Fillit HM, et al. Unintended benefits: the potential economic impact of addressing risk factors to prevent Alzheimer's disease. *Health Aff (Millwood)*. 2014;33:547–554.
- Kawachi I, Berkman LF. Social ties and mental health. *J Urban Health*. 2001;78:458–467.
- Bassuk SS, Glass TA, Berkman L. Social disengagement and incident cognitive decline in community-dwelling elderly persons. *Ann Intern Med*. 1999;131:165–173.
- Glei DA, Landau DA, Goldman N, et al. Participating in social activities helps preserve cognitive function: an analysis of a longitudinal, population-based study of the elderly. *Int J Epidemiol*. 2005;34:864–871.
- Seeman TE. Social ties and health: the benefits of social integration. *Ann Epidemiol*. 1996;6:442–451.
- Wang H, Megill A, He K, et al. Consequences of inhibiting amyloid precursor protein processing enzymes on synaptic function and plasticity. *Neural Plast*. 2012. <http://dx.doi.org/10.1155/2012/272374>.
- Rosenstiel T, Mitchell A, Purcell K, et al. How people learn about their local community. *Internet Sci Tech*. 2011;9:22–24.