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Bilingualism and Aging

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Abstract

Language mediates not only the social relationship systems, but also the control of cognitive processes. Potential differences between bilinguals and monolinguals in age-associated cognitive decline during normal and abnormal aging have been suggested. A research review of the area suggests that normal aging is associated with increased interference between the two languages. Regression to the primary language can be considered as a predictor of dementia. Recent research has reported that bilingualism can have a protective effect during aging. Bilinguals are usually faster in performing different attention tasks, and more efficient in tests of executive control. Research has supported the assumption that using two or more different languages frequently can provide not only some social, but also cognitive, advantages during normal and abnormal aging.

Language represents the major instrument of cognition. Language mediates not only the social relationship systems, but also the control of cognitive processes (“metacognition”; Luria, 1966). It can be conjectured that using one additional language to communicate is reflected not only in the pattern of brain organization and activity, but also in the characteristics of language decline during normal and abnormal aging. Interestingly, histopathological changes in the brain of bilingual individuals have been reported; thus, Mechelli et al. (2004) found that learning a second language increases the density of grey matter in the left inferior parietal cortex and the degree of structural reorganization in this region is modulated by the proficiency attained and the age at acquisition. Potential differences from monolinguals in the patterns of cognitive decline—specially, differences between the first (L1) and the second (L2) language— can be anticipated.

The purpose of this article is to review the literature and present key findings that highlight what is currently known about language abilities during aging in bilingual populations and the communication abilities of bilingual individuals with dementia.

Language During Aging

Diverse cognitive changes, including changes in language abilities, are observed during normal aging (e.g., Ardila, 2003; Connor & Obler, 2000; Craik & Bialystok, 2006; Peña-Casanova et al., 2009). Language knowledge represents a form of crystallized intelligence (i.e., learning knowledge and skills that are accumulated over the lifespan) and relies on specific, acquired knowledge such as vocabulary, fund of information, and reading. In general, language abilities increase up to about the 6th decade of life; afterwards, a progressive slow decrease usually is found. Table 1 outlines data (Ardila, 2007a) that support this premise.

Table 1. Calculated raw scores in the different WAIS-III verbal subtests. Means and standard deviations (in parenthesis) are presented (adapted from Ardila, 2007a)

	35-44	45-54	55-64	65-69	70-74	75-79	80-84	85-89
Vocabulary: Mean	44.4	46.5	41.0	41.0	41.0	40.5	35.5	35.0
SD	13.0	13.0	13.8	13.8	13.5	12.5	13.5	13.0
Similarities: Mean	23.5	23.5	21.0	20.0	20.0	19.5	17.5	16.5
SD	5.7	6.5	6.7	6.5	6.0	6.0	6.2	6.0
Arithmetic: Mean	13.5	14.5	13.5	12.5	12.5	12.0	11.0	10.0
SD	4.0	4.0	4.0	4.0	4.0	3.7	3.0	3.0
Digits: Mean	17.0	17.0	16.0	16.0	15.0	15.0	14.5	14.0
SD	4.2	4.2	4.5	4.2	3.2	4.0	3.7	3.2
Information: Mean	16.5	17.5	16.5	16.5	16.5	15.5	13.5	13.5
SD	5.7	5.7	6.0	6.0	5.7	6.0	5.5	5.5
Comprehension: Mean	21.5	22.5	20.5	20.5	20.5	19.5	17.5	16.5
SD	5.5	5.7	6.0	6.0	5.7	5.7	6.0	5.7
L-N sequence: Mean	11.0	10.0	9.0	9.0	8.0	8.0	7.0	6.0
SD	2.5	3.0	2.5	2.7	2.5	2.5	3.0	3.0

Bilinguals can communicate using two different language systems, but the pattern of language use frequently changes across the lifespan (Ardila, 2007b; Hyltenstam & Opler, 1989; Müller, 2009). Typically, the two languages can be associated with different social contexts and living situations; for instance, L1 can be the family language, whereas L2 is the working language. Sometimes the two languages are acquired simultaneously or close in time; but L2 also can be acquired late in life and related to working activities or migration. Sometimes L1 and L2 may be used simultaneously only during certain periods of life, for instance, during the active working life. The two languages also can be acquired early in life and maintained in active use throughout the whole life. Individuals living in bilingual societies may require the continued use of both languages. Indeed, a significant diversity of possibilities in the pattern of use of L1 and L2 across the lifespan can be found.

Two different questions can be considered in aging bilinguals' ability to communicate: (a) the ability to keep a single language in communicative conditions and to switch at will between both languages and (b) the potential aging effect on L1 and L2.

It has been proposed that aging may have a detrimental effect on the ability to use two different languages (Ardila & Ramos, 2007). For instance, aging has been related with increased interference between the two languages (Durga, 1978). Interference has been defined as the transference of elements of one language to another at various levels (phonological, grammatical, lexical, and orthographical; Berthold, Mangubhai, & Batorowicz, 1997). Alternation, or code switching, between languages occurs commonly among bilinguals and may take a number of different forms, including alternation of sentences and phrases from both languages succeeding one another and switching in a long narrative (Skiba, 1997). The bilingual has to select the appropriate language and to keep conversation within it. The bilingual also has to be able to switch between languages when required. The ability to select the appropriate language and switch between languages involves general executive processing and is regarded as a linguistic ability dependent upon frontal lobe activity (Hernandez, Dapretto, Mazziotta, & Bookheimer, 2001). With aging, this ability to select the appropriate language and make the correct switching when required decreases. The result is an increased mixture of both languages. Although during normal aging language mixing and switching can be limited (Gollan & Ferreira, 2009), it becomes significant in cases of dementia.

Rosselli et al. (2000) analyzed the influence of bilingualism on cognitive test performance in older adults. They administered verbal fluency and repetition tests to Spanish/English bilinguals. Verbal fluency was tested by eliciting a verbal description of a picture and by asking participants to generate words within phonemic and semantic categories. Repetition was tested using a sentence-repetition test. Results demonstrated equal performance of bilingual and monolingual participants in all tests except that of semantic verbal fluency. Bilinguals who learned English before age 12 performed significantly better on the English repetition test and produced a higher number of words in picture description than did bilinguals who learned English after age 12.

Other cognitive tests have been used with bilingual populations. For instance, Gollan et al. (2007) administered the Boston Naming Test to 29 Spanish-English bilinguals (mean age=74.0), first in their dominant language and then in their less-dominant language. Bilinguals with similar naming scores in each language, or relatively balanced bilinguals, named more pictures correctly when credited for producing a correct name in either language. Balanced bilinguals also named fewer pictures in their dominant language than unbalanced bilinguals and named more pictures correctly in both languages if the pictures had cognate names (e.g., dart/dardo). The authors concluded that bilinguals' ability to name pictures reflects their experience with word forms in both languages. Gollan et al. (2008), using a picture naming test, also observed that slowing related to aging was greater for producing low-frequency names in the dominant language, but when speaking the nondominant language, increased age attenuated frequency effects and age-related slowing was limited exclusively to high-frequency names. Rosselli et al. (2002) analyzed the performance of Spanish-English bilinguals on the Stroop Test. The Stroop Test is a psychological test designed to examine directed attention during a reaction time task (a color reading task). Participants consisted of 71 Spanish-English bilinguals, 40 English monolinguals, and 11 Spanish monolinguals. No significant differences were observed in color reading, but bilinguals performed worse in the color naming condition. No significant differences were observed in the color-word condition. The authors suggested that interference between both languages could account for the observed differences in the naming condition.

Bialystok, Craik, and Luk (2008) selected 96 participants, who were younger (20 years) or older (68 years) adults and either monolingual or bilingual; tasks assessing working memory, lexical retrieval, and executive control were administered. As expected, monolinguals and bilinguals performed similarly on working memory tasks, whereas monolinguals performed better on lexical retrieval tasks and bilinguals performed better on executive control tasks; there was some evidence for larger language group differences in older participants on the executive control tasks, suggesting an increased heterogeneity in older participants.

Noteworthy, bilinguals encode and retrieve certain autobiographical memories in one or the other language according to the context of encoding, and these linguistic characteristics are stable properties of those memories over time (Schrauf & Rubin, 2000). Autobiographical memories, in consequence, have not only a temporal and spatial dimension, but also a particular language association; they seem to be language-dependent memories.

Dementia

Communication abilities in bilingual patients with dementia and patterns of language decline for L1 and L2 in dementia are issues rarely mentioned in the dementia literature. It is well known, however, that the ability to maintain fluency in more than one language decreases with aging (Hyltenstam & Obler, 1989). With advancing age, people may tend to retreat to a single language, regardless of a life long history of bilingualism. L2 is frequently associated with active working life, and retirement often is associated with moving to a more limited familiar environment. Moreover, older bilinguals may have increased difficulties handling two different languages, due to the effects of cross-language interference. These effects in aging bilingual persons can be further exaggerated in those who develop dementia.

It has been suggested that in bilingual individuals, regression to a primary language may be associated with development of cognitive impairment and increased risk for development of dementia (McMurtray, Saito, & Nakamoto, 2008). Clinical observation suggests that frequently the initial dementia sign is the apparent difficulty to communicate in L2. McMurtray and colleagues described two bilingual

patients who presented with early symptoms of dementia after regression to their primary language; that is, the regression to the primary language was observed before the dementia symptomatology and, consequently, can be considered a predictor of dementia.

Mendez, Perryman, Ponton, and Cummings (1990) studied 51 patients who reported routine use of another language, as well as varying fluency in English. All patients were regularly exposed to English as a second language after age 13. Despite patients' differences in educational level, age at acquisition of English, frequency of use, and baseline fluency in English, all caregivers reported a greater preference of the patients for their original language and decreased conversation in English. Patients presented an evident tendency for words and phrases from the native language to intrude into English conversational speech. The authors found that bilingual dementia patients tended to present asymmetrical language impairment with preferential preservation and use of the first acquired language. They suggested that, in dementia, recently learned information is retained the least and older, more remote information often is relatively preserved, consistent with a regression toward the predominant use of the patient's earliest language. According to Mendez and colleagues, in dementia, a retreat to the original language could result from an exacerbation of the cross-language difficulties that typically increase with age. People who are bilingual never totally deactivate either of their two languages, and this can result in interference or intrusions, particularly from the dominant language into the other one. Dementia patients tend to mix languages, and they have special problems with language separation.

General cognitive functioning has been found to be higher in patients with dementia if communication is carried out in L1 rather than L2. Ekman et al. (1993, 1994) studied patients with dementia who were born in Finland and had migrated to Sweden (Finnish-Swedish bilinguals). They found that many of these Finnish immigrants had difficulties communicating with their Swedish-speaking caregivers, while their communication with Finnish-speaking caregivers was adequate. They observed that the frequent misunderstanding of a person's message often lead to a one-way communication, in which the caregiver commanded and interrupted the person with dementia. The Finnish immigrants with dementia functioned on a level of manifest competence that seemed far below their level of latent competence. The authors concluded that the presence of Finnish-speaking caregivers is an environmental change that would markedly enhance the Finnish immigrants' performance and quality of life and also reduce the costs for their care.

Mendez, Saghafi, and Clark (2004) studied two polyglot patients with semantic dementia. The first case was a 71-year-old man who experienced a slow, progressive loss of his ability to use and understand Spanish and German. The patient was a language teacher who had been fluent in Spanish and used it daily in his work. Confrontational naming in English was decreased. The patient had great difficulty understanding even common nouns in Spanish, and he was no longer able to understand any German words. On an aphasia battery, word comprehension was moderately impaired in English and severely impaired in Spanish and German. Words that were comprehended in Spanish or German were not consistently comprehended in English. His magnetic resonance imaging (MRI) studies showed anterior temporal atrophy, left greater than right. The second case was a 66-year-old man who had a 2-year history of progressive loss of the meaning of words and inability to retrieve words. Although Spanish was his first language, he spoke English at work and knew some Polish as well. His examination was intact except for naming and recognizing famous faces. Confrontational naming in Spanish was impaired. He could not name pictures of items and made some semantic errors (e.g., *zero* for *circle*). His performance was worse in English than in Spanish, and his Polish was lost. If he comprehended a word in one language, he did not necessarily comprehend it in the other language. His MRI scan showed left anterior temporal atrophy. The authors concluded that, in multilingual patients with semantic dementia, semantic anomia was progressively more impaired in their second and third languages compared to their primary languages. Words named and comprehended in one language were not consistently named and comprehended in other languages that they knew. These findings were interpreted as compatible with separate lexical semantic systems for each language.

Filley et al. (2006) reported a case of primary progressive aphasia in a bilingual English/Chinese woman; at the age of 70, she developed anomia that progressed to aphasia. At the age of 76, her functional neuroimaging disclosed mild left temporoparietal hypometabolism. Language testing revealed conduction-like aphasia that was comparable in the two languages, although English was slightly better

preserved. It was concluded that primary progressive aphasia had disrupted the two languages in a similar manner, suggesting their close neuroanatomic relationship in this case.

Usually, the difficulty in selecting the appropriate language observed in aging bilinguals becomes more significant in cases of dementia. It has been suggested that bilingual speakers with dementia, even in the early stages of deterioration, make errors in selecting the appropriate language and maintaining the correct language during conversational speech (Hyltenstam & Obler, 1989; De Santi et al., 1990). There is, however, a large variability in the extent of inappropriate language use, with some individuals showing more language mixing than others (Friedland & Miller, 1999). Hyltenstam and Obler described two cases of Alzheimer's disease in bilinguals. In one of them the major problem laid mainly in the area of language choice, whereas in the other the major difficulties were observed in the ability to separate the languages. De Santi et al. concluded that the ability to make the correct language choice and keep languages separated is correlated with the overall stage of dementia. The mixture may be so significant that it is not easy to recognize what language the patient is attempting to speak.

It is interesting that normal bilinguals can use the knowledge of two languages to increase verbal production, whereas dementia patients are unable to profit from the knowledge of two different languages. De Picciotto and Friedland (2001) studied verbal fluency abilities in 30 normal aging English-Afrikaans bilingual speakers and six bilingual subjects with Alzheimer's disease. A semantic verbal fluency task (animals) was administered in the bilingual mode, Afrikaans and English. There was no significant difference between monolingual and bilingual performance. It was observed that some normal bilingual subjects used code switching as a strategy; there was not, however, any relationship between age of acquisition, pattern of use, and verbal fluency scores. In comparison, subjects with Alzheimer's disease did not make use of code switching strategies, and there was some relationship between age of acquisition, pattern of use, and verbal fluency scores. It was concluded that normal bilinguals can rely on both languages in an attempt to improve performance; patients with dementia were unable to use this strategy.

During recent years, Bialystok and colleagues (Bialystok, Craik, & Klein R, 2004; Bialystok, Craik, & Ruocco, 2006; Bialystok, Craik, & Ryan, 2006; Bialystok, Craik, & Freedman, 2007; Craik & Bialystok, 2006; Craik & Bialystok, 2005; Fernandes, Craik, & Bialystok, & Kreuger, 2007) have reported several studies supporting the idea that bilingualism can have a protective effect during aging, attenuating the normal cognitive decline associated with aging and delaying the onset of dementia. In 2004, Bialystok and colleagues published an influential paper suggesting that bilingualism can reinforce executive functions, thereby compensating for the negative effects of aging. They compared the performance of monolingual and bilingual middle-aged and older adults on an executive function test (Simon task). Bilingualism was associated with smaller Simon effect costs for both age groups; bilingual participants also responded more rapidly to conditions that placed greater demands on working memory. In all cases, the bilingual advantage was greater for older participants. The authors proposed that controlling processing is carried out more effectively by bilingual individuals. They further suggested that bilingualism helps to offset age-related losses in certain executive processes. In a later study, Bialystok, Craik, and Freedman [2007] selected 184 patients diagnosed with dementia in a memory clinic; about half of them were bilinguals. It was found that bilingual patients showed symptoms of dementia 4 years later than monolinguals, all other measures being equivalent. Additionally, the rate of decline in Mini-Mental State Examination (MMSE) scores over the 4 years subsequent to the diagnosis was the same for a subset of patients in the two groups, suggesting a shift in onset age with no change in rate of progression.

In spite of the importance of the questions, excepting Bialystok and colleagues' research, just a few studies have analyzed the potential protective effect of bilingualism during normal and abnormal aging. Kavé, Eyal, Shorek, and Cohen-Mansfield [2008] examined a large population of elders, composed of 814 individuals with a mean age of 83 years. Data were drawn from a representative sample of the oldest Israeli Jewish population. These subjects were initially studied in 1989 and during the following 12 years, two follow-up studies were performed. Regression analyses showed that the number of languages spoken contributed to the prediction of cognitive test scores beyond the effect of other demographic variables, such as age, gender, place of birth, age at immigration, or education. Mohamed et al. (2004) examined the functioning of inhibitory mechanisms in younger and older bilinguals using a bilingual version of the Stroop test. They found that older bilinguals were slower when they responded in their non-

dominant language. Furthermore, older unbalanced bilinguals showed greater interlingual interference when they responded with their second language to visual stimuli written in their dominant language. Balanced bilinguals showed equivalent interference effects between all conditions. Departing from these results, the authors suggest that manipulating two languages may enhance the efficiency of inhibitory mechanisms.

Costa, Hernández, and Sebastián-Gallés (2008) considered that three different attentional networks can be distinguished: alerting, orienting and executive control. Comparing monolingual and bilingual subjects, the author found that bilingual participants were not only faster in performing different attention tasks, but also more efficient in the alerting and executive control networks. In particular, bilinguals were aided more by the presentation of an alerting cue, and were also better at resolving conflicting information. These results show that bilingualism exerts an influence in the attainment of efficient attentional mechanisms by young adults that are supposed to be at the peak of their attentional capabilities.

Conclusions

Bilingualism is a heterogeneous phenomenon and patterns of language use across the life-span are diverse. Research has supported the assumption that using two or more different languages can frequently provide not only some social but also cognitive advantages. Life experiences may be associated with the use of a specific language, and life memories are also associated with the contextual language existing when the memory was acquired. Seemingly, during normal aging there is a more rapid decline of L2 than L1, and elders tend clearly to prefer using L1. In case of dementia, the cognitive defect is more severe when the demented patient is tested in L2 than when tested in L1. Recent research has supported the suggestion that bilingualism can have a protective effect during age-associated cognitive decline, and even delay the onset of a dementia process.

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