The Relationship between Age of Language Acquisition and Lexical Richness in Aphasic Azari and Persian Bilinguals

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Abstract

Areas of science focusing on neurolinguistic structures underlying language representation and control are very intricate and knowledge in these areas is still preliminary. In the present study, the researchers aimed at studying possible relationships between age of L2 acquisition and L1 and L2 lexical richness in aphasic Azari and Persian bilinguals. Ten right-handed bilingual (Azari: L1 – Persian: L2) female patients who were diagnosed with Broca’s aphasia and were in the age range of 30 and 70 years were selected for the present study. Azari and Persian versions of the Bilingual Aphasia Test (BAT) were used for neurolinguistic assessments of the patients once at the time of onset of aphasia and also three weeks after the onset of aphasia. According to the results, no significant difference was found between age of language acquisition and L1 and L2 lexical richness after the onset of aphasia and also three weeks after the onset of aphasia (p > 0.005). Thus, age of language acquisition probably does not have any effects on degrees of impairments as well as improvements observed in L1 and L2 lexical richness in Azari and Persian bilinguals. However, further larger studies are suggested.

Keywords: Age of Language Acquisition, Bilingual, Aphasia, Lexical Richness.
Introduction

Complex neural mechanisms of human language systems have always been an intriguing area of research and study in neurolinguistics. Numerous studies aimed to determine the most important principles of cerebral language organization in bilingual brains. Yet, one area of lively research in the field of neurolinguistics is focused on how bilingual brain represents two languages and whether bilinguals possess one general (“fused”) language representational system or two distinct (“differentiated”) language representational systems (De Houwer, 1999; Lanza, 2000; Grosjean, 2001; Mueller & Hulk, 2001; Petitto et al., 2001; Fernandez, 2002). Some researchers advocate that young bilinguals' two language systems are “fused” into one general language system during early childhood and do not become differentiated in two linguistic systems until the ages of 4 to 5 years (Vihman, 1985; Volterra & Taeschner, 1978). On the other hand, a number of psycholinguists believe that young bilinguals develop two differentiated linguistic systems from early infancy on (Petitto & Kovelman, 2003; Holowka, Brosseau-Lapré, & Petitto, 2002; Petitto et al., 2001; De Houwer, 1999; Pearson, Fernandez, & Oller, 2003; Petitto et al., 2001; De Houwer, 1999; Pearson, Fernandez, & Oller, 1993; Genesee, 1989). Thus, there is still controversy over the issue whether bilingual language processing draws upon one common neural system or two distinct neural systems (one for each language).

Another highly-debated issue in the arena of bilingualism is the effect of critical period in second language learning and its possible effect on neural organization of a bilingual brain. Indeed, early childhood has been identified to be a key period when neural and synaptic organization of the brain takes place (Petersson, Reis, & Ingvar, 2001; Roder, Stock, Bien, Neville, & Rosler, 2002; Fine, Finney, Boynton, & Dobkines, 2005; Pettito et al., 2000). Early linguistic exposures have been shown to result in permanent neurological and behavioral changes (Kovelman, Shalinsky, Berens, & Petitto, 2008), and formation of the most similar neural and synaptic organization between the two languages within a single brain (McDonald, 2000; Johnson & Newport, 1989). Individuals not exposed to a second language before puberty (or even before 7-years of age) probably will not achieve native-like linguistic proficiency later in life (Lenneberg, 1967; Mayberry, Lock, & Kazmi, 2002).

Some invaluable insights to language storage in the brain come from studying bilingual individuals suffering from aphasia. Different patterns of recovery of the two languages in the aphasic bilinguals are likely to reflect some linguistic factors including age of linguistic acquisition, linguistic proficiency, and level of usage of the two languages prior to the onset of aphasia and the nature of the damage to the neural architecture underling representation and
control of the languages. Various neural and psychological mechanisms have been proposed to account for nonparallel recovery patterns of bilingual aphasic patients (e.g. Paradis, 1985; Obler, 1984). Thus, differential linguistic organization both within and between two brain hemispheres have also been proposed. Indeed, some argue that if neural processes differ across two languages within an individual brain, then differential patterns of recovery should be observed in the aphasic bilinguals. However, there are various factors that may contribute to the nonparallel recovery pattern of aphasic bilinguals. Factors including age of L2 acquisition, language proficiency, and language use are thought to play a role in pattern of recovery of the bilingual aphasic patients. As it is very difficult to study all contributing factors in a single study and given the fact that age of language acquisition is one of the challenging and debating notions in the arena of linguistics and psycholinguistics, the researchers chose to study age of language acquisition as one of the possible variables.

The aim of the present study was to investigate the effects of age of L2 acquisition in impairment as well as recovery of dual lexical systems in the aphasic bilinguals. In other words, the researchers aimed at studying possible relationships between L1 and L2 lexical richness and age of L2 acquisition in aphasic bilinguals. To our knowledge, to date, no one has studied the relationship between age of language acquisition and L1 and L2 lexical systems in Azari and Persian bilinguals.

Methods

Ten right-handed Bilingual (Azari: L1 – Farsi: L2) female patients who were diagnosed with Broca’s aphasia (due to cerebrovascular accident (CVA) and head trauma) and were within the age range of 30 and 70 were selected for the study. They were also matched according to their education, and medication use. Moreover, they were not on any kind of psychoactive medication, caffeine or other drugs. Patients with co morbidities (i.e. cardiovascular diseases, renal disease, and malignancies) were excluded from the study. They used both languages on a daily basis before onset of aphasia. The participants or their relatives were all asked to sign written consent forms regarding participating in the study. For the purpose of neurolinguistic assessment, the researcher used Farsi and Azari version (Paradis, Bahar, Dehghan, & Nilipour, 1987; Paradis, Paribakht, & Nilipour, 1987) of the bilingual aphasia test (BAT) once at the time of onset of aphasia and also three weeks after the onset of aphasia. BAT is designed to assess each of the languages of a bilingual or multilingual individual with aphasia in an equivalent way and the various versions of the BAT are culturally and linguistically equivalent tests (Paradis, 2004). Neurolinguistic category of lexical richness was calculated by dividing total vocabulary used in
the individual’s speech in a given time by the number of the vocabulary types (e.g. grammatical type such as noun or verb) (Paradis, Paribakht, & Nilipour, 1987). Then, the extent of damage to lexical systems in both L1 and L2 at two time points (at the onset of aphasia and three weeks after the onset of aphasia) were compared for each individual. Furthermore, the improvements observed in the scores of lexical richness based on BAT were calculated. Data were entered IBM Statistical Package for Social Sciences (SPSS) software (version 21.0; Chicago, Illinois). Pearson correlations were used to examine possible correlations between age of L2 acquisition and recovery of lexical systems in L1 and L2.

**Results**

Mean age of the patients were found to be 58.5 ± 1.60 SD. No significant difference was found between the patients regarding age, gender, smoking, medication, and education before the study (p>0.05).

Mean lexical richness index after onset of aphasia was found to be 0.43 for L1 and 0.46 for L2. Mean lexical richness index, three weeks after the onset of aphasia was found to be 0.60 for L1 and 0.56 for L2.

No significant relationship was found between age of L2 acquisition and L1 and L2 lexical richness after the onset of aphasia and three weeks after the onset of aphasia (Table 1 & 2).

**Table 1 Correlation between Age of L2 Acquisition and L1 and L2 Lexical Richness after the onset of aphasia**

<table>
<thead>
<tr>
<th></th>
<th>Pearson Correlation</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age of L2 Acquisition &amp; L1 Lexical Richness after the Onset of Aphasia</td>
<td>0.275</td>
<td>0.443</td>
</tr>
<tr>
<td>Age of L2 Acquisition &amp; L2 Lexical Richness after the Onset of Aphasia</td>
<td>0.342</td>
<td>0.333</td>
</tr>
</tbody>
</table>

**Table 2 Correlation between Age of L2 Acquisition and L1 and L2 Lexical Richness Three Weeks after the onset of aphasia**

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<table>
<thead>
<tr>
<th>Pearson Correlation</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age of L2 Acquisition &amp; L1 Lexical Richness after the Onset of Aphasia</td>
<td>-0.348</td>
</tr>
<tr>
<td>Age of L2 Acquisition &amp; L2 Lexical Richness after the Onset of Aphasia</td>
<td>0.015</td>
</tr>
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</table>

**Discussion**

Aphasic studies are more focused on finding the best pharmacotherapy and rehabilitation techniques for the patients. Few studies have attempted to study different features of bilingualism and language acquisition in the aphasic cases. Indeed, literature reviews show that studies on how languages are lost and retrieved again and how different aspects of languages are stored within a single brain have rarely been a topic of scientific investigation in bilingual aphasic subjects, especially in Iran. The aim of the present study was to investigate the relationship between age of language acquisition and L1 and L2 lexical richness in aphasic Azari and Persian bilinguals. To the best of our knowledge, no one has studied possible relationship between age of language acquisition and L1 and L2 lexical richness in a population of Azari-Farsi bilinguals. No significant difference was found between age of language acquisition and L1 and L2 lexical richness after the onset of aphasia and three weeks after the onset of aphasia. L2 lexical richness was slightly better than L1 after the onset of aphasia and L1 lexical richness was slightly better than L2 in all patients.

The present findings are probably in contrast with the idea proposed by Stemmer & Whitaker (2008) who advocate that the later the second language is learned (especially if it is learned in a formal environment through instruction), the more likely it is that individuals will gain greater amounts of metalinguistic knowledge that may be spared by the aphasia-causing brain damage and that may further be exploited in the therapy.

It is widely believed that age of L2 acquisition is predictive of L2 proficiency. To put another way, age of language acquisition is observed to have a significant negative correlation with attained L2 proficiency (Birdsong, 2006; DeKeyser & Larson-Hall, 2005). The areas of language most commonly investigated are morphosyntax and pronunciation. Typically, morphosyntax errors in production or grammaticality judgments increase with increased age of language acquisition.
acquisition, as does degree of judged nonnative accent. Across many studies that examined factors that might influence L2 success, it has emerged that, of all the investigated variables, age of language acquisition is reliably the strongest predictor of ultimate L2 attainment.

There is still controversy regarding the nature and mechanisms underlying lexical processing deficits in monolingual and bilingual individuals with aphasia (Kiran et al., 2014). Theories of normal bilingual language processing indicate variable degrees of overlap between the two languages. For instance, the revised hierarchical model (Kroll, et al., 2010) which allows for language proficiency differences by proposing connections between both L1 and L2 and the semantic system. The mentioned connections differ in their strengths as a function of fluency in L1 relative to L2. In bilingual individuals with a dominant language, the lexicon of L1 is generally assumed to be larger than that of L2. Moreover, lexical associations from L2 to L1 are assumed to be stronger than those from L1 to L2. To put it another words, the lexical link is stronger in the L2-L1 direction than in the L1-L2 direction. Accordingly, during L2 acquisition, bilinguals learn to associate every L2 word with its L1 equivalent, thus forming a lexical-level association that remains active and strong. Conversely, the links between the semantic system and L1 are assumed to be stronger than from the semantic system to L2. With regards to activation of phonological representations from the semantic system, the prevailing theory suggests that activation flows from the semantic system to the phonological system of both languages simultaneously, indicating that lexical access is target language-nonspecific (Costa, et al., 2006).

In another study, Rosselli et al. (2000) compared Spanish-English bilinguals with English monolinguals and Spanish monolinguals on word fluency task using either phoneme letter cues or semantic categories. They found a lower performance in the bilingual participants compared to their monolingual counterparts on the semantic category cued task and not on the phoneme letter cue task. They advocated that the shared elements of concrete nouns across languages may further the interference between the two languages. Moreover, age of L2 acquisition of L2 had an impact as bilinguals who learned English (L2) earlier in life, performed significantly higher than later learners on English versions of the tests.

Tschirren et al. (2011) conducted a research on the interaction of late age of language acquisition on L2 syntactic deficits in bilingual aphasia. A total of 12 late bilingual patients with aphasia were examined. According to the results, as a group, the L1 and L2 aphasia severity scores did not differ; however, four patients with lesions in the prerolandic area exhibited lower scores in L2 syntactic processing compared to L1 syntactic processing.
It is hoped that findings of the present research will shed light on the linguistic representational system within a bilingual brain and pave the way for better understanding of the extent of neurolinguistic architecture underlying human language. The findings probably provided data on the degree of contribution of age of L2 acquisition to the amount of recovery of different lexical systems in L1 and L2. However, further larger studies taking into account other factors such as linguistic proficiency and degree of linguistic use is also suggested.
References


