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Exploring the Impact of Bilingualism on Semantic and Phonological Neuropsychological Tasks in Adults

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ABSTRACT

Background: Numerous studies have yielded conflicting results concerning the disparities in verbal (semantic and letter) fluency between monolingual and bilingual individuals. Given the linguistic variations among bilinguals and the influence of cultural differences on language, this study examined verbal fluency in Kurdish and Azari bilinguals and compared it with that of Farsi monolinguals.
Methods: This cross-sectional study involved 30 Farsi monolingual students, 28 Kurdish-Farsi bilinguals, and 29 Azari-Farsi bilinguals. The study utilized semantic (fruits and animals) and letter fluency tasks (/f/, /a/, and /s/). Each bilingual participant was instructed to perform the verbal fluency tasks twice: once in their native language and once in Farsi.
Results: In both fluency tasks, bilinguals demonstrated superior performance in Farsi compared to their mother languages (Azari and Kurdish) (P<0.001). Furthermore, no significant differences were observed between bilinguals and monolinguals in the formal language of their community (Farsi).
Conclusion: The formal language in Iran (Farsi) predominates among bilingual individuals. This is likely because the educational system and formal writing are conducted in Farsi. Bilinguals typically use their native language only for conversations within their native context and with their peers.

Introduction

Bilingualism is defined in various ways across different sources. Bilingual individuals differ in their usage of the two languages. Most studies categorize bilingual individuals based on their acquisition age and proficiency level in both languages [1]. According to Hoffman, bilingualism implies speaking both languages equally fluently in any given situation. However, another definition of bilingualism encompasses using a second language in real-life scenarios [2]. Factors such as the age of second language acquisition, the style of learning the second language, and patterns of language use are

considered significant in definitions of bilingualism [3]. According to Bloomfield, a bilingual individual can use or control two languages like a native speaker. However, this definition can be influenced by varying degrees of language proficiency in each language, especially in cases of imbalanced bilingualism. Bilingualism can be categorized into different types, such as early and late bilingualism, based on the age of second language acquisition (Cohen, 1976). Early bilingualism refers to acquiring a second language during childhood, while late bilingualism pertains to learning a second language after age 7. Grosjean, Nelson, and Harris reported that at least half of the world's population is bilingual [1]. As stated in Ethnologue, in Iran, the population of bilinguals speaking the languages under study in this research consists of 10,900,000 Azerbaijani speakers and 5,590,000 Kurdish speakers [4].

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In numerous studies, vocabulary stimuli have been utilized to investigate the degree of linguistic dependence in the lexical storage systems of bilinguals. To examine bilingual performance in vocabulary, it is essential to select an appropriate task that can highlight the differences between various interdependent languages [3]. Semantic and letter verbal fluency tasks can assess word naming in specific categories or words beginning with specific letters. Various studies have reported conflicting results regarding the differences in verbal fluency between monolingual and bilingual individuals. However, the findings in other languages remain controversial; the results obtained among bilinguals are highly valued compared to those among monolinguals.

It has been reported that semantic fluency is better in bilinguals than monolinguals in some cases [5, 6], while in other instances, it is lower in bilinguals [7-10]. Regarding letter fluency, bilinguals may outperform monolinguals [10, 11], although some studies have found no difference between the two groups [5, 9]. Several studies have investigated the effects of demographic factors on vocabulary level, i.e., verbal fluency, in bilinguals regardless of the type of bilingualism [12-14]. For instance, age and level of education are influential factors in semantic fluency, with age being particularly significant [13]. Performance is influenced more by gender, age [15], and level of education than by language [9, 12, 16]. However, other findings suggest a greater effect of language on verbal fluency [6]. Letter fluency, particularly clustering, is linked to language acquisition and education, while semantic fluency, especially clustering, is associated with age [14]. Another study found no correlation between the age of acquisition and verbal fluency [17]. Chomsky's theories and hypotheses on language acquisition are grounded in the advanced mechanisms of the brain. Chomsky posits that humans have inherent linguistic capabilities or 'switches' that allow them to learn languages by adhering to rules. It is thought that individuals can switch between languages depending on their usage. Given the inconsistencies in the findings, the differences between languages in bilinguals, and the influence of cultural differences on language, the present study investigated verbal fluency in Kurdish and Azari bilinguals (L1). This was based on common bilingual hypotheses [18] and aimed to determine and compare the performance of verbal fluency in bilinguals in their native (L1) and formal languages (L2). Differences in the vocabulary level between these languages have led researchers to investigate whether Kurdish-Farsi bilinguals, Azari-Farsi bilinguals, and Farsi monolinguals perform similarly in semantic and letter categories. The current study has potential implications for researchers in this field, especially in our country, where a significant portion of the population is bilingual. Aside from its research implications, the findings can also be applied in the clinical domain, specifically for bilingual individuals who have experienced brain damage. This is because the results provide insights into the proficiency levels of bilingual individuals in their first and second languages. In this study, bilingual students learned their native language (L1) first, which is their mother tongue. Subsequently, they learned Farsi as their second language (L2).

Methods

Participants

This cross-sectional study, conducted from 2014 to 2016, involved 30 Farsi monolingual, 28 Kurdish-Farsi bilingual, and 29 Azari-Farsi bilingual students from Tehran University of Medical Sciences. There is no definitive tool for determining the degree of bilingualism in bilingual studies. Therefore, self-rating has been suggested as one of the most useful and effective assessment tools. In this method, subjects rate their comprehension, speaking, reading, and writing abilities on a five or 7-point scale in both languages [19, 20]. In our study, bilingual participants were asked to rate their proficiency in a second language from 1 to 5. Participants who scored three or more on proficiency [8] were included in the study. The inclusion criteria for both groups were: 1) no history of head injury, tumor, epilepsy, stroke, or other neurological diseases, 2) no history of psychiatric disorders, 3) no history of sensory disorders such as hearing and vision problems, 4) age between 18-30 years old, 5) at least one year of university education, 6) being an undergraduate or postgraduate student, and for bilingual subjects, having proficiency in both languages (obtaining a score of 3 or more in the self-rating questionnaire).

All ethical principles were considered in this study. The current study was approved by the Tehran University of Medical Sciences (91-03-125-19326)

Materials and Task

In this study, both semantic and letter fluency tasks were utilized. For semantic fluency, the subject was asked to name categories of fruits and animals. In contrast, for letter fluency, the subject was asked to name words beginning with the three letters /f/, /a/, and /s/ within one minute. It should be noted that each bilingual subject was asked to fill out the consent form and then perform the verbal fluency tasks twice (once in their native language and once in Farsi) in a random order. In bilingual subjects, L1 refers to the native language (i.e., Kurdish and Azari), and L2 refers to the Farsi language; all monolingual subjects spoke Farsi. All subjects' responses were recorded in both languages and subsequently analyzed by speech therapists who were experts in those languages. A native Kurdish and a native Turkish Speech-Language Pathologist (SLP) conducted the tests and collected the samples. Both were postgraduates.

The Shapiro-Wilk test was utilized to verify the normal distribution of the data. The Mann-Whitney U test was used to compare monolingual and bilingual subjects' semantic and letter fluency. The Wilcoxon rank-sum test was applied to compare Kurdish and Azari with Farsi among bilinguals. The data were analyzed using SPSS software, version 16. A p-value of less than .05 was considered statistically significant.

Results

In this study, 87 subjects participated, including 30 monolingual (Farsi) and 57 bilingual (Kurdish and Azari)

individuals. The participants comprised 45 males and 42 females with a mean age of 20.99±1.11 years. There was no significant difference in age (P=0.932), gender (P=0.902), and the time spent after entering the university (P=0.375) between the two groups- bilinguals and monolinguals.

- Comparison of Semantic and Letter Fluency in L1 and L2 of Monolinguals and Bilinguals

Figures 1 and 2 present the findings related to verbal fluency, both semantic and letter fluency, in L1 and L2 of bilingual and monolingual subjects. These figures indicate a lower mean semantic and letter fluency for bilinguals than for monolinguals.

- Comparison of Semantic and Letter Fluency between L1 and L2 in Bilinguals

The results demonstrated that the mean values for the number of recalled fruits and animals, as well as overall semantic fluency in the first language (L1), were significantly different compared to the second language (L2) in bilinguals (P<0.001). A similar trend was observed for letter fluency (P<0.001), except for the number of words beginning with /s/ among Azari speakers (Table 1).

-Comparison of Semantic and Letter Fluency in Farsi between Bilinguals and Monolinguals

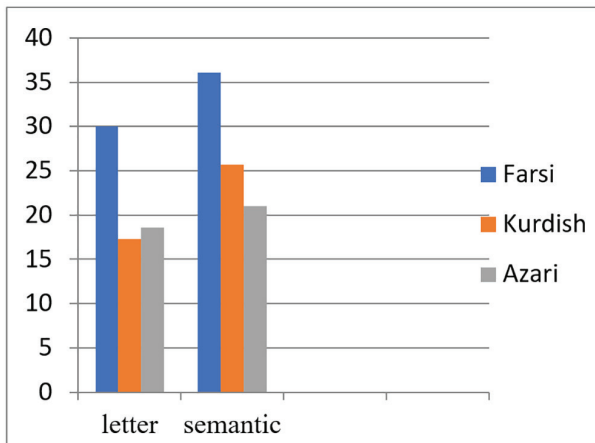The mean values for semantic and letter fluency in Farsi

(for monolingual speakers) were higher than those in bilingual speakers' second language (L2). However, these differences were not statistically significant (P>0.05).

-Comparison of Semantic and Letter Fluency in L1 between Bilinguals and Monolinguals

There was a significant difference in the mean semantic fluency in the first language (L1) between the groups (H(2)=40.72, P<0.001). Dunn's post-hoc test revealed that the mean score of semantic fluency in native Farsi speakers (monolinguals) was significantly higher than that in the first language of Kurdish and Azari individuals (bilinguals) (P<0.05). Additionally, the mean semantic fluency in the first language of Kurdish individuals was significantly higher than that in the first language of Azari individuals (P<0.05).

Regarding letter fluency, a significant difference was also observed between the first languages (L1) of the groups (Farsi, Kurdish, and Azari) (H(2)=31.19, P<0.001). However, no significant difference was found in the mean semantic fluency in the first language of the two bilingual groups (Kurdish and Azari) (P>0.05).

Discussion

Despite differences in vocabulary levels among these languages, the researchers aimed to determine whether Kurdish-Farsi and Azari-Farsi bilinguals and Farsi
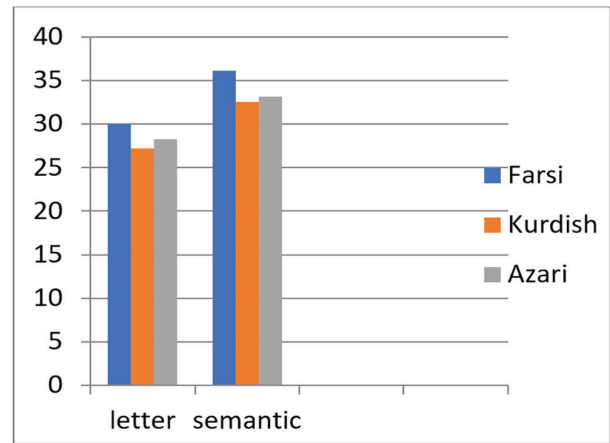

Figure 1: Semantic and letter fluency averages in L1 (Kurdish and Azari) bilinguals and monolinguals

Figure 2: Semantic and letter fluency averages in L2 (Farsi) bilinguals and monolinguals

Table 1: Comparison of semantic and letter fluency mean scores between native language and Farsi language in bilingual subjects

	Language			P†
	Native language	L1*	L2**	
Fruit number	Kurdish	12.43 (3.07)	14.21 (2.90)	0.006
	Azeri	9.62 (4.40)	14.34 (4.45)	>0.001
Animal number	Kurdish	13.29 (3.85)	18.32 (4.80)	>0.001
	Azeri	11.38 (4.10)	18.79 (6.07)	>0.001
Semantic fluency	Kurdish	25.71 (6.16)	32.53 (6.44)	>0.001
	Azeri	21.00 (6.82)	33.13 (9.73)	>0.001
/f/ number	Kurdish	4.89 (2.60)	8.00 (2.98)	>0.001
	Azeri	3.21 (2.73)	9.07 (3.38)	>0.001
/a/ number	Kurdish	5.14 (2.15)	9.39 (4.00)	>0.001
	Azeri	7.52 (2.35)	9.34 (3.34)	0.032
/s/ number	Kurdish	7.29 (2.80)	9.82 (4.19)	0.003
	Azeri	7.86 (2.68)	9.83 (3.44)	0.055
letter fluency	Kurdish	17.32 (6.24)	27.21 (8.87)	>0.001
	Azeri	18.58 (5.84)	28.24 (8.59)	>0.001

*L1: native language; **L2: Farsi language; Values are shown as "(standard deviation) mean score"; †Wilcoxon rank-sum test

monolinguals perform similarly or differently in word retrieval across semantic and letter categories. In this study, we attempted to control for certain influential demographic factors. Consequently, an equal number of bilinguals of both genders and types were selected from two academic levels, each with a self-assessment score higher than average (above 3 out of 5 points) in second language proficiency. However, the findings obtained between the two languages were highly controversial compared to monolinguals. These findings are discussed in the following sections.

Verbal fluency is often impaired in various disorders, particularly neurological ones. Therefore, addressing this ability can improve other aspects of speech and language. In several studies, single-word stimuli have been utilized to assess the degree of linguistic dependence in bilinguals' vocabulary storage systems [3]. Consequently, to evaluate bilinguals' performance at the vocabulary level, selecting appropriate tasks highlighting the differences between various interdependent languages is crucial.

- Comparison of L1 and L2 of Monolinguals and Bilinguals

There is a significant difference in semantic and letter fluency between bilinguals (Azari-Farsi and Kurdish-Farsi) across their two languages. However, monolinguals and bilinguals did not differ in the Farsi language. Notably, these two fluency tasks in the native language showed a significant difference between the two groups. Specifically, monolinguals outperformed bilinguals (Azari-Farsi and Kurdish-Farsi) in their native languages.

- Comparison of L1 and L2 in Bilinguals

In response to the question of how bilinguals perform in both semantic and letter fluency tasks in Farsi and their mother language (i.e., Azari or Kurdish), the results generally indicated that bilinguals performed better in Farsi than in their mother language (Azari and Kurdish) in both fluency tasks. This behavior can be attributed to these individuals' formal and educational language. Bilinguals use their mother language more for verbal communication within their community, while they use the Farsi language for both verbal and written communication at the university [21]. Based on the present study's findings, students reported a higher preference for using their native language for verbal communication. Therefore, it can be inferred that the formal written language can influence their native language. Various bilingual studies have shown that bilinguals usually have separate written-verbal systems [5-8]. However, in the Iranian population, bilinguals did not have a separate written and formal language system in their native language for communication.

-Comparison of Farsi between Bilinguals and Monolinguals

Bilinguals did not significantly differ in semantic and letter fluency tasks compared to monolinguals. This indicates that bilinguals (Azari-Farsi, Kurdish-Farsi) and monolinguals (Farsi) perform similarly in the

formal language of their community (Farsi language). Bilingualism could not differentiate performance in semantic and letter fluency tasks. This finding is consistent with those obtained on semantic fluency in the study by Luo et al. [11] and is also in line with those obtained on letter fluency in the studies by Portocarrero et al. [7] and Roberts et al. [22]. These studies also found no difference in the two verbal fluency tasks in their bilingual studies.

However, other studies have pointed to these differences and reported that bilingual subjects recalled fewer words than monolinguals in verbal fluency tasks, and the difference between monolinguals and bilinguals was greater in semantic fluency [8, 10]. Blumenfeld et al. stated that verbal fluency has similar patterns and more words in semantic fluency tasks than letter fluency tasks in the dominant language (English) of monolingual and bilingual Spanish-English speakers [23].

Generally, these differences may be due to the type of bilingualism, age of acquisition of two languages, learning style of two languages, level of education, amount of language usage for two languages, and the differences between the languages.

-Comparison of L1 between Bilinguals and Monolinguals

As previously mentioned, the results showed that in all verbal fluency tasks, monolinguals performed significantly better in Farsi than Azari-Farsi and Kurdish-Farsi bilinguals did in their mother language. This is largely attributed to the dominance of the formal spoken and written language over the mother language of bilinguals, which can influence the number of words they speak. When a speaker lives in a bilingual environment or uses a second language frequently, the vocabulary, phonology, and prosody are influenced by the second language [1].

Regarding demographic characteristics, the results showed no significant differences between the two genders and different ages in the semantic and letter fluency of monolinguals and bilinguals in both languages. This finding contradicts the studies investigating the effect of gender, age, and level of education in bilinguals [13-15]. Therefore, this discrepancy between results may be due to differences in sample size, age range, exposure age to the second language, and second language acquisition.

For Azari-Farsi and Kurdish-Farsi bilinguals in Iranian society, their bilingualism appears to be rooted in the patterns of language use. This allows them to easily switch between two languages in all situations or use a language only in specific places, situations, or with specific people. As a result, these individuals develop their particular language skills in one language. For example, they learn reading, writing, speaking, comprehension, translation, and interpretation in Farsi (the formal language of their country). At the same time, they may use another language (their mother language, namely Azari and Kurdish) only to communicate verbally with people in their community. Accordingly, different aspects of one language are used in this context.

Most studies have pointed out that language skills vary in bilinguals. Therefore, verbal fluency in each language should be studied separately as one of the executive

function tasks. However, some studies have confirmed that if there is high proficiency in both languages, this function can be studied only in one language [16]. This presents one of the contradictions in the field of bilingualism.

Finally, verbal (semantic-letter) fluency tasks in bilinguals appear unsuitable for assessing their linguistic ability. This ability is influenced by various factors such as the degree of exposure to two languages, level of language proficiency, and age of acquisition, among others. Supporting this point, meta-analysis studies have stated that bilingualism confers advantages in inhibition, shifting, and working memory tasks but not in monitoring or attention. Findings on verbal fluency tasks also revealed a bilingual disadvantage, likely due to less exposure to each language when both languages are used equally [24].

Future studies should consider incorporating a comprehensive analysis of verbal fluency in conjunction with other cognitive, linguistic, and executive functions. Additionally, it would be intriguing to explore variations in this function among different types of bilingual individuals, considering factors such as the age of language acquisition and methods of acquisition. Researchers also recommend conducting analogous studies across various disorders in bilingual populations.

Conclusion

There was no difference in verbal fluency in the Farsi language between monolingual and bilingual individuals. However, the two groups observed a significant difference in the mother tongue. The Farsi monolinguals outperformed the Azari-Farsi and Kurdish-Farsi bilinguals in their native language. The formal language in Iran (Farsi) appears to dominate the language of bilingual individuals. This dominance is likely because the educational system conducts studies and formal writing in Farsi. Bilinguals typically use their native language only for conversations within their native context and with peers.

Acknowledgments

Conflict of Interest: None declared.

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