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RESEARCH ARTICLE

Test-retest reliability and list equivalency of Persian quick speech in noise test in Azari-Persian bilinguals

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Abstract

Background and Aim: The quick speech in noise (Q-SIN) test results have been reported to be entirely different in monolinguals compared to bilinguals. We attempted to assess the reliability and equivalency of the Persian Q-SIN test in Azari-Persian bilinguals.

Methods: The Q-SIN test was performed on 51 Persian monolinguals and 51 Azari-Persian bilinguals by the 1st, 2nd, 3rd, and 5th lists binaurally under headphone. The signal-to-noise ratio (SNR) loss was determined for each group. The reliability was evaluated on 30 bilinguals.

Results: There was no gender effect on all results in both groups. The mean SNR losses of four lists were -1.19 and -0.8dB in monolinguals and bilinguals, respectively, also they were within normal limits in both groups. The mean SNR losses for all lists in monolinguals were better than those in bilinguals, but there was a significant difference between two groups for list 1 (p=0.03). No significant differences were observed between two runs for lists 1, 3, and 5 in bilinguals, and two runs for lists 1, 2, and 5 were significantly correlated. There were no significant differences between the scores of lists 2, 3, and 5 in bilinguals (p>0.000), and a moderate correlation existed between lists 2 and 3.

Conclusion: The scores of lists 2, 3, and 5 in bilinguals are similar to those in monolinguals. In bilinguals, lists 1 and 5 are reliable, and lists 2 and 3 are equivalent. The overall results indicate limitations in both reliability and equivalency of Persian Q-SIN lists in the bilinguals.

Keywords: Bilingual; list equivalency; monolingual; quick speech in noise test; reliability

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Introduction

Speech perception in noise includes a set of perceptual and cognitive skills that allow the auditory system to segregate the sounds heard and detect the target signal. In everyday life, speech is often heard along with competing noise, and thus, speech perception involves segregating the sounds and then detecting the desired signal [1,2]. Speech perception in noise is one of the most complicated tasks that people normally encounter. Sometimes an individual's hearing may be quite normal in audiometry terms, but he or she may have difficulty understanding speech in noise, indicating the hearing impairment is central [3]. Speech perception in noise depends on the interaction of the sensory and cognitive processors. To recognize the target

stimulus from the background noise, one should first shape an auditory object on the basis of temporal features. Creating an auditory object is a necessary step in stream segregation, a phenomenon that helps one get the meaning from multiple sources existing in the environment. At least, part of the ability to create an auditory object and segregate several sources into distinct streams is done by up-down cognitive processes such as attention and memory [3,4]. Speech processing in noisy environments is done in several stages. Cognitive and linguistic signs make up for the lost details while the performance of auditory brainstem is modulated and regulated through higher levels and up-down processes [3].

The processing characteristics of the hearing system in bilinguals have received much attention in recent decades due to the differences between bilinguals and monolinguals in terms of auditory-verbal processing abilities. Bilinguals process the linguistic information in noisy environments differently from monolinguals [5]. Some studies have shown that perception of the second language in bilinguals is influenced more in noisy environments than in silence [6]. We can use various tests to understand individuals' problem with speech perception in noisy environments. Some of these tests are the Speech in Noise (SIN) test, the Bamford-Kowal-Bench-SIN (BKB-SIN), the hearing in noise test (HINT), and the quick speech in noise (Q-SIN) test. The Q-SIN test is a quick test used to quantify hearing ability in noise [7,8]. Several individual and environmental factors affect the perception of speech in noise. The individual variables include stimulation from environmental factors and hearing impairment, auditory processing, age, language and cognition (memory) [9]. The Persian version of Q-SIN was developed by Tahaei and tested on some hearing-impaired people by Khalili et al. in terms of reliability and internal consistency [10]. Besides, newer versions of this test were prepared by Shayanmehr et al. that were used on some hearing-impaired people [11]. The reliability and internal consistency of their lists were examined on hearing-impaired people by Hanilou et al. [12].

The Persian Q-SIN test can detect the amount of difficulty in understanding SIN and to prescribe suitable hearing aids to monolingual Persian speakers. However, it is important to consider bilingualism and various ethnic groups in Iran. According to statistics, about half of Iranians speak Persian as their mother tongue, and the other half speak other languages such as Azari, Kurdish and Arabic languages. Multilingualism is a common phenomenon in Iran and is not limited to specific areas. About 24% of Iran's population speak Azari [5]. Considering the effects of bilingualism on speech perception in noise, also the fact that most complaints of hearing impaired people are related to hearing in noise, and given that there is no speech in noise test for Azari language, we decided to examine the Persian version of the Q-SIN test on Azari-Persian bilinguals. The aim of this study was to evaluate the equivalency and reliability of the Persian Q-SIN test on early Azari-Persian bilinguals and to compare their scores of the Q-SIN test with those of Persian monolinguals.

Methods

This is a cross-sectional and comparative-analytical study conducted on a sample of 102 Persian monolinguals and early 18- to 40-year-old Azari-Persian bilinguals (n=51; 25 males and 26 females in each group). The monolinguals were called to the School of Rehabilitation of Tehran University of Medical Sciences (TUMS), and the early bilinguals were selected based on the records of students in the School of Rehabilitation, TUMS, who were born in one of the Azari speaking cities of West and East Azerbaijan and Ardebil provinces and were MSc or PhD students. They first filled a demographic questionnaire, general health status, hearing, handedness status, and languages that they used in their communications in order to be placed in one of the two groups. Based on the Edinburgh questionnaire [13], both groups scored higher than +5, were right-handed, had no hearing difficulty in noisy environments, and no etiological and neurological problems such as head trauma, accidents, brain surgery or a

Table 1. Demographic information of monolinguals and bilinguals

		Mean (SD)		
Group	**Male/Female**	**Pure tone average**	**Age**	**Handedness laterality**
Persian monolingual	51 (25/26)	4.8 (3.8)	24.67 (4.27)	9.65 (1.53)
Azari-Persian bilingual	51 (25/26)	4.73 (4.7)	24.35 (3.97)	9.72 (1.22)

history of psychiatric medications. The monolinguals completed the questionnaire, and their rating for the second language was less than 5 (intermediate middle on a 10 point scale) [13]. The bilinguals were also given the second language questionnaire and their rating for the Persian language skills was above 5 [13].

Informed consent was obtained from the participants. We were assured of the subjects' normal hearing through otoscopy, pure tone, speech audiometry, and acoustic immittance.

We utilized a Lenovo laptop to perform the Q-SIN test. To do so, we used the Persian Q-SIN test CD [11]. List 4 lacked reliable results and discarded. The test was conducted in the Audiology Clinic of School of Rehabilitation, TUMS. Before the test, the laptop volume and the output of headphone (model 4152) were calibrated in an artificial ear (B&K, Denmark) by SLM (Model 2235, B&K, Denmark). Sentences were presented at 70 dB HL [14]. To eliminate the order effect, the lists were coded and presented in random order for each subject. Before starting the test, the subjects were given relevant instructions. On receiving the sentences on the handset, the subjects took notes of the sentences that they heard. To familiarize the subjects with the test, we initially presented a sample list to them.

The number of correctly written words were counted for each list, and the signal to noise ratio (SNR) loss was calculated as SNR loss=27.5 – total correct words – Persian SNR-50.

Persian SNR50 has been calculated as –4 [11]. This number can be placed in the formula or used in noise settings in the CD [15]. As this number has been applied in the CD, we used the original formula in this study [12].

To evaluate the reliability of the test, we administered the re-test for 30 bilinguals within three to four weeks.

We used the paired t-test to evaluate the reliability of the Persian Q-SIN test and the Spearman non-parametric test to evaluate the correlation of each list in the two runs of the test. The Friedman test and Wilcoxon complementary test corrected by Bonferroni were also used to evaluate the equivalency level of the lists. Correlation between scores of four lists was assessed with Spearman test. We also used the Independent t-test to compare the results of the two groups, and the Mann-Whitney test for gender comparison. The data were analyzed using SPSS 17 at a significance level of $p<0.001$ for Wilcoxon test corrected by Bonferroni and $p<0.05$ for the other tests.

Results

The demographic results of the monolingual and bilingual groups in this study are presented in Table 1. The test-retest mean results for the four lists of the monolingual and bilingual groups are given in Table 2. There was no significant difference between the test-retest results of lists 1, 3, and 5 of bilinguals ($p>0.05$), but there was a significant difference for list 2 ($p=0.03$). The correlation coefficients of the test-retest of bilinguals were 0.75 and 0.8 for list 1 and list 2, respectively, indicating a high correlation. The correlation coefficient for list 5 was 0.58, showing a moderate correlation. The correlation coefficient for list 3 was 0.11 ($p=0.57$), indicating a weak correlation.

For equivalency of the lists, the Friedman test showed that the lists were not equivalent ($p=0.000$), but the post hoc test showed that list

Table 2. Test-retest reliability of the Persian quick speech in noise test in early Azari-Persian bilinguals and monolinguals

	Persian monolingual (n=31)			Azari-Persian bilingual (n=30)		
	Mean (SD) score			Mean (SD) score		
List	Test	Retest	p	Test	Retest	p
1	-0.11 (0.72)	-0.24 (0.63)	0.26	0.17 (0.8)	0.00 (0.73)	0.10
2	-1.18 (0.75)	-1.4 (0.65)	0.05*	-1.00 (0.82)	-1.20 (0.7)	0.03*
3	-1.53 (0.66)	-1.4 (0.6)	0.1	-0.97 (0.82)	-1.30 (0.48)	0.07
4	-1.66 (1.07)	-2.08 (0.67)	0.005*	-1.53 (1.03)	-180 (0.88)	0.07

1 was not equivalent with the other lists (p=0.000) while lists 2, 3, and 5 were equivalent with one another (p>0.000).

Comparing the results of monolinguals and bilinguals indicated that they had a significant difference with respect to list 1, but no significant differences were observed in lists 2, 3, and 5 (p>0.05). Moreover, no significant difference was observed between the males and females of monolingual and bilingual groups in terms of their mean SNR loss in lists 1, 2, 3 and 5 (p>0.05) (Table 3).

Discussion

The mean SNR loss for the four lists was obtained as -1.19 and -0.8 dB for the monolingual and the bilingual subjects, respectively, whereas the mean of SNR loss had been obtained as 0.35 dB for the five lists in a study conducted by Shayanmehr et al. [11].

As for the reliability of the Persian Q-SI0N test, there was no significant difference between the mean SNR loss of the lists test-retest and showed repeatability. A difference was observed in list 2, which can be attributed to the effect of learning in the re-test due to the improved mean of 0.2 (the SNR loss of the test and the re-test being -1.00 and -1.20, respectively, in list 2). Evaluation of the correlation coefficients of the test-retest results for the four lists of the present study showed a high correlation in lists 1 and 2 in the bilingual group, a moderate correlation (0.58) in list 5, and no correlation in list 3 (0.11). On the whole, it can be said that lists 1 and 5 of the bilingual subjects were reliable.

As for equivalency of the lists in the bilingual group, the average SNR loss of the lists was found to be significantly different. To learn about the difference of the mean SNR loss of the lists, we compared the mean SNR loss of each list with the other lists separately. It was found that there was a significant difference between list 1 and the rest of the lists, but lists 2, 3 and 5 were equivalent to no significant difference. The study conducted by Shayanmehr et al. also showed that all lists were equivalent [11]. However, Khalili et al. showed that all lists were equivalent except for lists 1 and 4 [10]. Wilson et al. studied the equivalency of 18 English lists, showing that only lists 1, 2, 6, 8, 10, 11, 12, 15, and 17 were equivalent [8].

The Spearman correlation test also showed that list 2 had a moderate correlation with list 3 in the bilingual group, and there was no correlation among the other lists, which may be due to the small sample size in this study. Shayanmehr et al. also showed no significant correlation among lists 3 and 1, 4 and 1, as well as 5 and 2 [11].

The effect of gender on the Q-SIN test score was not observed in any list of the two groups in this study. No such gender difference was observed in the study performed by Shayanmehr et al. [11]. A study carried out by Khalili et al. using the original version of Persian Q-SIN test on young and old groups showed the effect of gender only on the results of list 3 [10]. Hanilou

Table 3. Comparison of mean Persian quick speech in noise score of monolingual and bilingual men and women in each list using the Mann-Whitney test (n=51)

	Mean (SD) in monolinguals			Mean (SD) in bilinguals		
List	**Male (n=25)**	**Female (n=26)**	**p**	**Male (n=25)**	**Female (n=26)**	**p**
1	-0.22 (0.84)	-0.04 (0.65)	0.52	0.38 (0.38)	0.08 (0.86)	0.22
2	-1.18 (0.69)	-0.96 (0.70)-	0.27	-0.78 (0.79)	-1.15 (0.80)	0.13
3	-1.5 (0.65)	-1.46 (0.45)	0.60	-0.86 (0.90)	-1.04 (0.76)	0.44
4	-1.66 (0.80)	-1.92 (1.03)	0.07	-1.38 (1.20)	-1.65 (0.92)	0.50

et al. showed a significant difference only for people with normal hearing and only between list 2 and list 3, which is probably due to the low number of the men and women participants used for gender comparison [12].

Comparing Q-SIN test scores of monolingual and bilingual subjects revealed a significant difference only in list 1, and no significant difference was observed among lists 2, 3, and 5. Considering the total mean scores of the lists, which were -1.19 and -0.8 for the monolingual group and bilingual group, respectively, and considering that the SNR loss of the bilingual group was worse in list 1, the difference may be attributed to different processing of bilinguals [5].

Lucks Mendel and Widner studied SIN in a sample of English speaking subjects and Spanish-English bilinguals. They used Q-SIN, BKP-SIN, and word in noise tests in order to measure SNR loss and SNR-50 for the two groups. The mean SNR-50 of the Q-SIN test was 2.08 dB for the monolinguals and 7.6 dB for the bilinguals, and the SNR loss in the Q-SIN was 0.08 for the monolingual group and 5.6 for the bilingual group. A comparison of the groups showed significant differences among them with regard to the Q-SIN and BKB-SIN tests [16]. Krizman et al. investigated the auditory processing of Spanish-English bilingual vs. English monolinguals with different stimuli. The Q-SIN test showed the poorer performance of the bilinguals than the monolinguals in understanding the sentences produced in noise, and there was a significant difference between the two groups [17]. The equivalency and reliability of the lists of the Q-SIN test were not evaluated on bilinguals in the studies performed by Krizman et al., Lucks Mendel and Widner, but the findings of the present study indicating a significant difference between the two groups for list 1 are consistent with their findings [16,17].

Conclusion

This study evaluated the reliability and equivalency of the lists of the Persian Q-SIN test, revealing normal SNR loss in the bilingual group for all lists. There was a significant difference between the monolingual and bilingual groups only in the mean of list 1, and lists 2, 3, and 5 had similar results in both groups. These lists can be used in the bilingual group, but since lists 1 and 5 were reliable and lists 2 and 3 were equivalent in the bilingual group, the use of the Persian Q-SIN test for this group faces limitation. We recommend administering the Persian Q-SIN test for a larger Azari-Persian bilingual group with a wider age range and different levels of education and designing a SIN test in Azari.

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Conflict of interest

The authors declared no conflicts of interest.

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