



Bilingualism and its Effects on Speech Perception in Noise

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Introduction

As of 2017 it was estimated that 21.3% of Americans are bilingual. Different languages vary in their components (phonology, morphology, syntax, and semantics) with some languages resembling one another acoustically, and others showing less similarity. For bilingual speakers, listening in everyday situations requires differentiation between the different acoustic signals which compromise both of their languages. This becomes particularly difficult in complex listening environments, such as in the presence of background noise.

Speech perception in background noise can be expressed using two measurements: SNR-50 and SNR loss. SNR-50 is defined as the signal-to-noise ratio (SNR) necessary to correctly identify 50% of a speech signal. SNR loss is the difference in SNR necessary for an individual to understand a speech signal to the same degree as a person with normal hearing. The expected SNR loss for a person with normal hearing sensitivity is between 0 and 2 dB.

Multiple studies have shown that bilingual speakers with normal hearing sensitivity perform more poorly on speech-in-noise as compared to monolingual English speakers. Mendel and Widner (2016) performed a similar study showing that bilingual Spanish-English speakers had statistically poorer SNR-50 and SNR loss measures as compared to monolingual English speakers. These results indicated that even though these bilingual Spanish-English speakers had normal hearing, their speech perception performance in noise was comparable to a listener with a hearing loss. The present study examined speech perception in noise ability for bilingual speakers of Arabic and English.

Research Questions

1. Is there a difference in speech perception-in-noise ability between bilingual Arabic-English and Spanish-English speakers?
2. What is the difference in speech perception-in-noise ability between Arabic-English bilingual speakers and monolingual English speakers?
3. Within bilingual groups, does language dominance correlate to English speech perception abilities?

Methods

Participants

Bilinguals	Monolinguals
Arabic as a first language	Native English speakers
N = 16 (8 Female, 8 Male)	N = 15 (8 Female, 7 Male)
Ages: 18-61 years (\bar{x} = 25.63)	Ages: 22-34 years (\bar{x} = 25.07)
Normal Hearing	Normal Hearing

Methods (cont.)

Stimuli

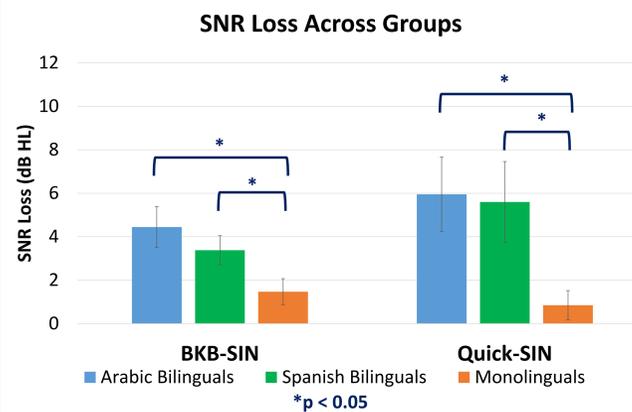
	Quick-SIN	BKB-SIN	HINT	WIN
Number of lists	4 lists	3 list pairs	2 lists	2 lists
Stimuli	Sentences	Sentences	Sentences	Words
Presentation level	70 dB HL	70 dB HL	65 dB HL	80 dB HL
Background Noise	Four-talker babble	Four-talker babble	Speech spectrum noise	Six-talker babble
SNR Range	+25 to 0 dB	+21 to -6 dB	Adaptive	+24 to 0 dB
SNR Step Size	5 dB	3 dB	2-4 dB	4 dB

Procedure

1. Participants completed an English proficiency questionnaire
2. Bilingual participants completed the Bilingual Language Profile to calculate language dominance
3. Standard audiometric hearing screening performed
4. Speech-in-Noise Testing with 3 sentence tests and 1 word test; all test lists were presented in a randomized order
 1. Quick-SIN
 2. BKB-SIN
 3. HINT
 4. WIN

Results

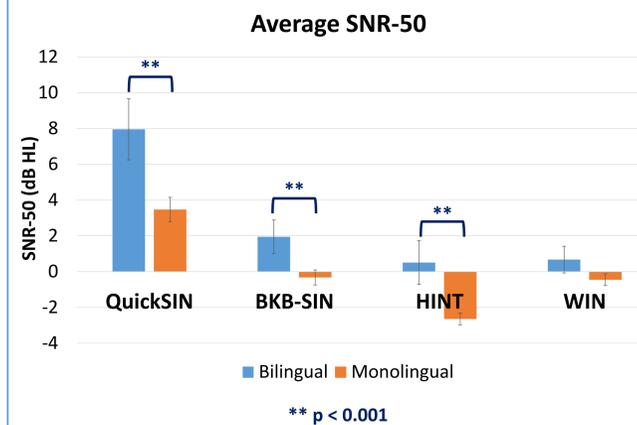
Spanish vs. Arabic: SNR Loss



- Both bilingual Arabic-English and Spanish-English groups showed a similar degree of SNR loss for the Quick-SIN and the BKB-SIN.
- Regardless of their first language, bilingual speakers exhibit the same degree of SNR loss in noise comparable to a listener with hearing loss.

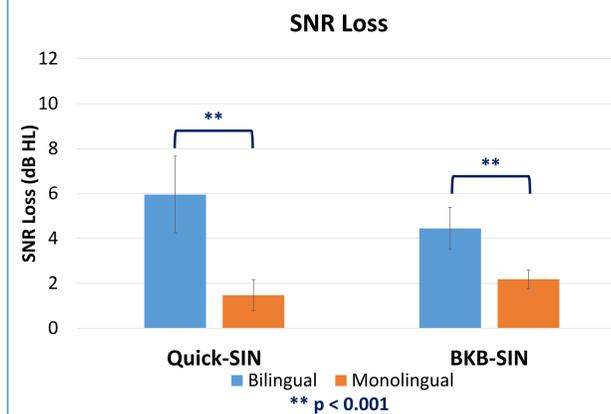
Results (cont.)

SNR-50



- The average SNR-50 for Arabic-English speakers was significantly poorer than for monolingual English speakers for the Quick-SIN, BKB-SIN, and HINT ($p < 0.001$).
- No significant differences were found between the groups for the WIN test. The monosyllabic words in the WIN are presented at a higher intensity level (80 dB HL) and the speech stimuli are easier than sentences.

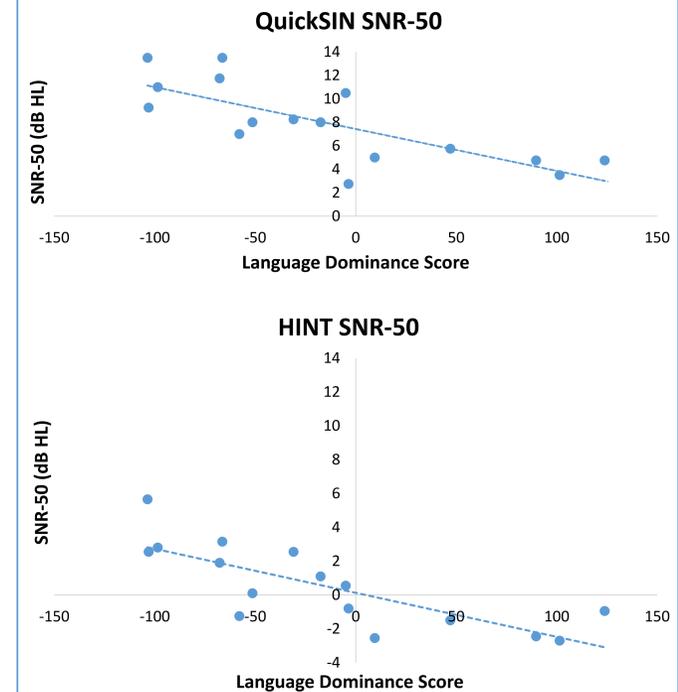
SNR Loss



- The average SNR loss for Arabic-English speakers was significantly poorer than for the monolingual English speakers for both the Quick-SIN and the BKB-SIN ($p < 0.001$).
- On average, bilingual speakers exhibited a mild SNR loss across tests.

Results (cont.)

Language Dominance



- A significant negative correlation was observed between SNR-50 and the language dominance score for the Quick-SIN and the HINT ($p < 0.001$).
- This correlation shows the more dominant individuals are in Arabic, the poorer they performed on the Quick-SIN and HINT tests.
- A negative correlation between SNR-50 and language dominance approached significance for the BKB-SIN and WIN tests.

Conclusion

Findings support the hypothesis that bilingual Arabic-English speakers have poorer speech perception in noise abilities as compared to monolingual English speakers. Despite having normal hearing, these bilingual listeners perform like individuals who have hearing loss when understanding speech in noise. These findings are consistent with those obtained by Mendel and Widner (2016), who also found a mild SNR loss for Spanish-English bilinguals.

Reference

Mendel, L., Widner, H. (2016). Speech perception in noise for bilingual listeners with normal hearing. *International Journal of Audiology*, 55(2), 126-134.