A Toad and a Frog are Hard to Tell Apart: English as a Second Language Affects Speech in Noise

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Introduction

Understanding speech in noise is a challenging listening situation for individuals with normal hearing as well as those with hearing loss. Speech-in-noise ability can be quantified by using 2 common measurements: SNR-50, which refers to the signal-to-noise ratio (SNR) at which 50% of words are correctly repeated, and SNR Loss, which refers to the increase in SNR required by a listener to obtain 50% correct words, sentences, or words in sentences, compared to normal performance. Measuring SNR Loss allows clinicians to recommend appropriate amplification and discuss realistic expectations. The QuickSIN, BKB-SIN, and WIN are three tests that can measure SNR-50 and/or SNR Loss.

Research suggests that bilingual speakers with normal hearing perform worse in their second language when the signal is degraded or presented in noise. In addition, bilingual speakers have longer processing times in both their first and second languages (Magiste, 1985; Nelson et al., 2005), and often rely more on bottom-up cues of speech rather than their linguistic experience (top-down processing) to fill in missing information. This reliance on the acoustic signal may add to bilingual speakers' degree of difficulty when listening to speech in noise.

According to the U.S. Census Bureau (2007), 19.7% of the population spoke a language other than English at home. For 62.3% of those people, Spanish or Spanish Creole was the language spoken. In 2011, the Hispanic population of the United States reached 50 million. According to the Pew Hispanic Center, this number is estimated to reach 127 million by 2050. Given the increase in the Hispanic population in the United States, it is important to understand the challenges faced by this population in understanding speech in noise.

Purpose

To measure SNR-50 and SNR Loss for two groups of listeners with normal hearing: native English speakers and non-native English speakers whose native language is Spanish.

Specific Research Questions

1. Is the magnitude of observed SNR loss for non-native English speakers due to test difficulty of the QuickSIN, BKB-SIN, or WIN, or is it truly an effect of second-language use?
2. If audiologists intend to use tests normed with native English speakers with their Spanish-speaking patients, how do they accurately interpret those results?

Method

Participants

Native English Speakers	Non-Native English Speakers
Normal Hearing	Normal Hearing
N = 12 (8 females, 4 males)	N = 10 (7 females, 3 males)
Age range: 23-53 Mean age: 28	Age range: 18-57 Mean age: 35
	Proficient in English • Mean English Proficiency Score: 92% • Mean duration of English usage: 21.7 years

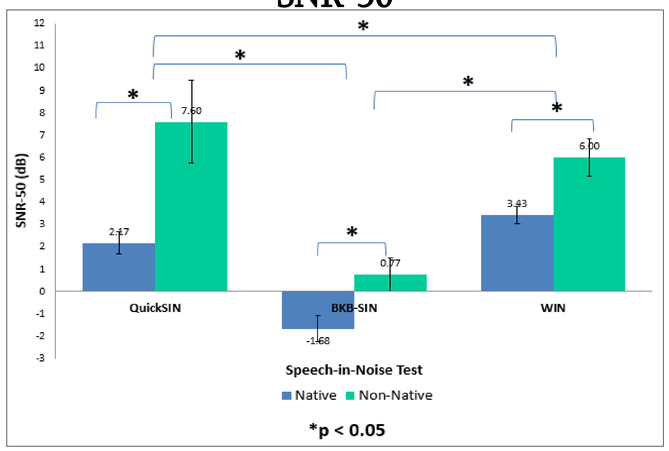
Procedure

Native English Speakers	Non- Native English Speakers
Otoscopy	Otoscopy
Tympanometry	Tympanometry
Air Conduction Testing (250-6000 Hz)	Air Conduction Testing (250-6000 Hz)
Speech-In-Noise Testing	Speech-In-Noise Testing
	English Proficiency Questionnaire
	Subjective English & Spanish Use Questionnaire

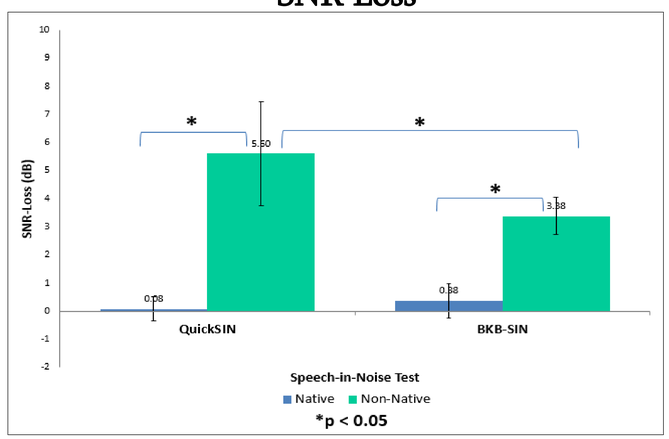
Speech-In-Noise Testing

	QuickSIN	BKB-SIN	WIN
Number of Lists	4	3	2
Stimuli	Sentences	Sentences	Monosyllabic Words
Presentation Level	70 dB HL	70 dB HL	80 dB HL
Background	4-talker babble	4-talker babble	6-talker babble
SNR Range	+25 to 0 dB	+21 to -6 dB	+24 to 0 dB
SNR Step Size	5 dB	3 dB	4 dB

SNR-50



SNR Loss



Results

Despite normal hearing and English proficiency, non-native English speakers had elevated SNR-50s and measurable, mild SNR Loss on all tests .

Non-Native English Speakers:

- SNR-50 results for the BKB-SIN were significantly better (lower) than the QuickSIN and the WIN
- No significant differences in SNR-50 were found between the QuickSIN and the WIN
- Significantly greater SNR Loss was measured on the QuickSIN compared to the BKB-SIN

Native English Speakers:

- SNR-50 results were significantly different on all tests, with the BKB-SIN scores significantly lower (better) than the QuickSIN, which in turn was significantly lower (better) than the WIN
- Minimal SNR Loss was measured (<1 dB), and no significant difference was found for SNR Loss between the QuickSIN & BKB-SIN tests

Conclusion

Both second language use and test difficulty influenced speech –in-noise perception.

How do we apply this knowledge?

1. Speech-in-noise testing provides important diagnostic and potential rehabilitative information not available from a simple audiogram!
2. When selecting a test, consider your patient's daily communication partners and environment. What is the language most commonly used? If Spanish is used more frequently, the BKB-SIN may be a more appropriate test.
3. Despite normal hearing, bilingual listeners may benefit from assistive technology. Bilingual hearing aid users likely will benefit greatly from directional microphone technology, even with mild hearing losses.

Future Directions

1. Measuring speech-in-noise performance with bilingual students to determine necessary classroom modifications.
2. Measuring speech-in-noise abilities with bilingual listeners with hearing loss.

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