The Bilingualism Paradox

By Nina Kraus, PhD; & Travis White-Schwoch

How does bilingualism affect listening? We think of bilingualism—and language experience more broadly—as a form of auditory learning. Children who grow up speaking multiple languages have enriched auditory environments. They need to focus on making multiple sound-to-meaning connections in their ongoing interactions. While they are speaking one language, they need to actively suppress the other. This stimulates the development of inhibitory control—the ability to suppress irrelevant information. Indeed, bilinguals have stronger inhibitory and executive skills than their monolingual peers (*PNAS*. 2012; 109[20]:7877).

This experience also shapes auditory processing. Bilinguals have stronger neural processing of the fundamental frequency (F0) in speech (*PNAS*. 2012). The F0 is a major cue used for identifying and tracking auditory objects and, therefore, is crucial to communication in complex soundscapes. Indeed, individuals with stronger neural processing of the F0 hear better in noise than their peers. It also makes sense that inhibitory skills are important to hearing in noise. After all, when trying to listen in a restaurant, shutting out the din is often harder than focusing on a single talker.

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Given bilinguals' stronger inhibitory control and neural profile, it would seem that they would excel at understanding speech in noise. However, bilinguals actually perform more poorly than monolinguals in noisy environments.

Krizman and colleagues sought to understand this disadvantage by systematically studying listening-in-noise skills across a spectrum of simple to complex tasks (*Biling Lang Cogn*. In press). They studied this in a cohort of adolescents, half of whom were bilinguals balanced for English and Spanish, the other half were monolinguals. The bilinguals had already exhibited advantages in inhibitory control and neural


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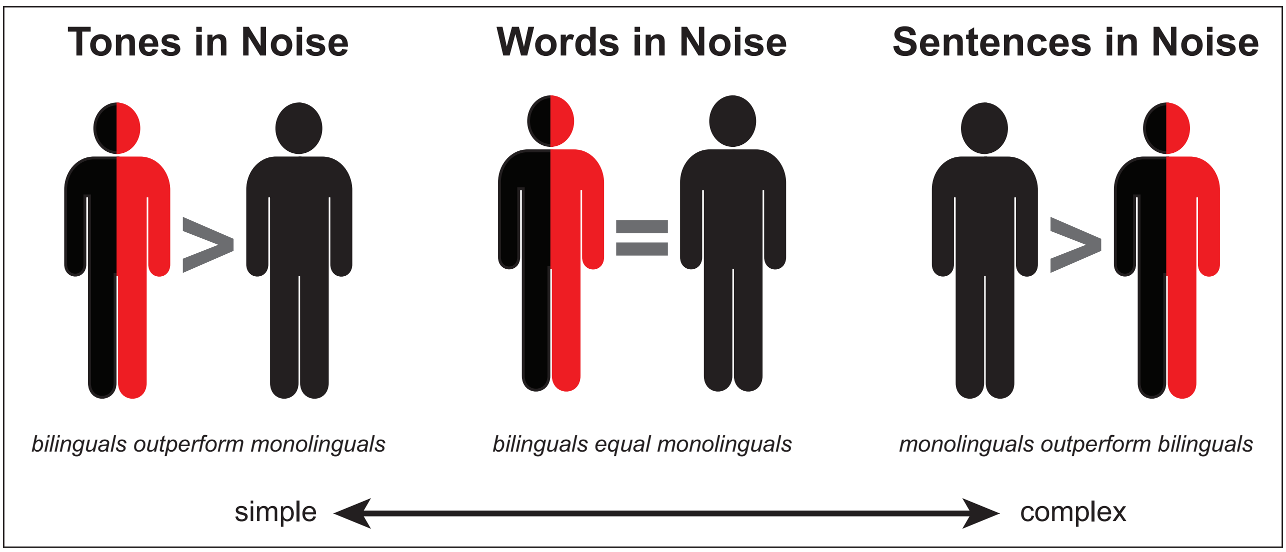

Image Credit/Kraus and White-Schwoch

Bilingualism interacts with the linguistic complexity of the message when listening in noise. Bilinguals had superior tone-in-noise detection than monolinguals; in contrast, bilinguals had worse sentence-in-noise perception than monolinguals. The two groups perform similarly understanding words in noise. Thus, when considering speech-in-noise perception, we need to keep a listener's language experience in mind (Biling Lang Cogn. In press).

processing of the F0, confirming that they were better equipped to listen in noise.

Krizman, et al., tested these children in a series of assessments that varied in complexity of listening scenarios. They administered:

- Two tests of tone-in-noise detection (simplest): listeners had to identify a tone embedded in, or immediately followed by, a burst of noise;
- A test of word-in-noise perception: listeners had to identify words (NU-6) presented amid multitalker babble (QuickSIN); and
- Two tests of sentence-in-noise perception (most complex): listeners had to recall sentences presented against speech-shaped noise (HINT) or multitalker babble.

Bilinguals performed better on the tone-in-noise tests. Bilinguals and monolinguals performed equivalently on the words-in-noise test. However, monolinguals performed better than bilinguals on the sentence-in-noise test. Thus, depending on the circumstances, bilinguals can have an advantage or disadvantage when listening in noise.

Of note is that bilinguals struggled as the linguistic complexity of the task increased. Tone-in-noise detection requires no linguistic knowledge, whereas sentence-in-noise perception relies on vocabulary, syntax, and context. A given sound could activate multiple words in either English or Spanish. If they mistakenly activate a Spanish word, they may focus primarily on neighboring Spanish phonemes and words while the sentence passes them by. Therefore, despite their cognitive and neural advantages, this linguistic bottleneck can still post a liability to understanding speech in noise.

This study reinforces the complexity of listening in noise and shows that no single strategy can improve listening skills in all patients. Even individuals with cognitive advantages and strong neural profiles can be confounded by other barriers, such as their language experience. This also reinforces that, in certain circumstances, tests of tone and word perception in noise are not good indicators of sentence-in-noise perception, and vice versa.

From a clinical standpoint, this emphasizes the importance of considering a patient's language background when evaluating listening skills. For example, a bilingual patient may perform more poorly on QuickSIN despite having a similar audiogram as a monolingual patient. This does not necessarily indicate that the bilingual patient is a stronger candidate for amplification or directional microphones. An important next step is to identify strategies, such as training, that might improve sentence-in-noise perception in bilingual patients.

The Challenges of Adapting to a New Power Hearing Aid

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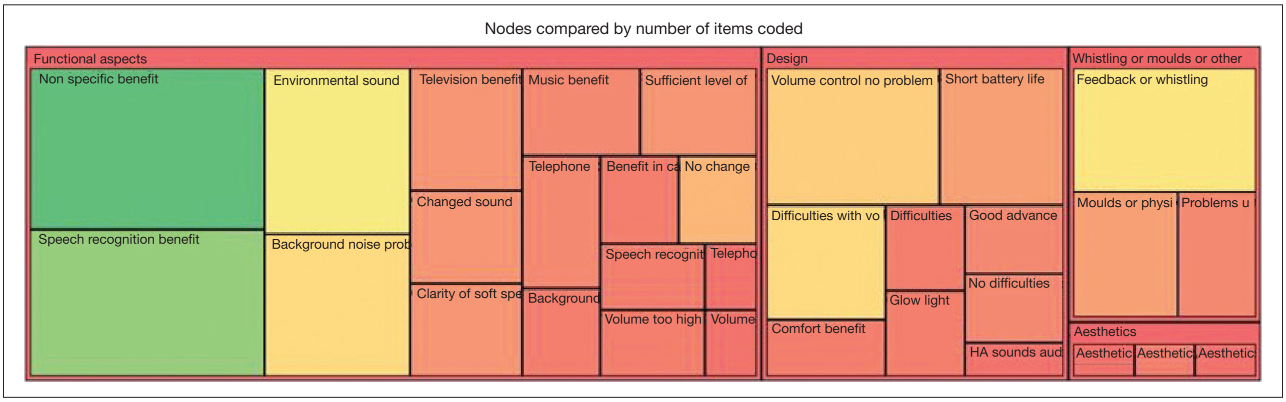

Figure 3. The distribution of themes within the qualitative interviews. The color and size of the boxes correspond to the frequency of response for each theme. Cooler colors and larger sizes indicate higher frequency of responses.

study, new molds were not made for the new hearing aids per the study protocol. The decision not to make new molds was based on wanting to compare the sound quality and signal processing of the current versus the new hearing aid without adding extra advantage or disadvantage to either hearing aid. The feedback experienced by almost half of the participants pointed to a need for new and better fitting ear molds and tubing. Many experienced feedback and less than satisfactory fit with the new hearing aids coupled with old ear molds and tubing. Based on observations from the interviews, new ear molds are needed when changing from one super power hearing aid to another to secure optimal conditions for feedback management and user comfort. Regarding the device's design, having the volume control on the ear caused issues for some users. Exploring other means of volume control may be beneficial for the adaptation of the new hearing aid. These practical issues of feedback and good fit may represent a more substantial challenge to the successful uptake of a new hearing aid than the actual listening experience.