



Published in final edited form as:

ASHA Lead. 2009 June 16; 2009: .

Music and Cochlear Implants:

Not in Perfect Harmony

Kate Gfeller

Introduction

Jana has been fitting Barry Jameson's hearing aids since he was identified with a mild hearing loss at age 5. Over time, Barry's hearing loss has become more severe. At 16, he scores poorly on speech perception tests and he is getting less benefit from his hearing aids. Barry's parents are considering a cochlear implant (CI). They've heard very positive reports about how CIs enhance speech perception, but Barry's parents also heard that they aren't so great for music, which Barry loves. He has been actively involved in music at school and listening to music always has been a favorite pastime. Mrs. Jameson would like Jana's input regarding CI use when listening to speech and music.

In discussing the pros and cons of cochlear implantation, audiologists can draw on considerable research evidence regarding the benefits for speech perception. With current technology, adult CI recipients can achieve excellent word recognition in a quiet listening environment following three to six months of implant use (Wilson, 2000).

The precise temporal and coarse spectral cues that characterize signal processing effectively transmit the most salient features of speech.

Unfortunately, coarse spectral cues are less effective in transmitting several key aspects of musical sounds (Kong, Stickney, & Zeng, 2004). CI recipients have similar perceptual accuracy as listeners with normal hearing for rhythm, but significantly poorer perception and appraisal of pitch, melody, and timbre (tone quality) (Gfeller, Oleson, Knutson, Breheny, Driscoll, & Olszewski, 2008). This difference helps to explain why many CI recipients show improved speech perception after a few weeks of implant use but do not show significant long-term improvements in music perception (Gfeller et al., 2008).

Audiologists can help CI recipients optimize their perception of music by encouraging clients to:

- Use song lyrics to compensate for poor pitch and melody perception.
- Recognize that music sometimes functions as background noise.
- Use residual hearing to enhance music and speech perception.

Song Lyrics as a Listening Strategy

Music is all around us, and one way we connect with our environment is by recognizing favorite songs. Songs associated with special events—graduation, weddings, or holidays—can form an “auditory scrapbook” of our lives.

Kate Gfeller, PhD, is F. Wendell Miller Distinguished Professor in the School of Music and the Department of Communication Sciences and Disorders at the University of Iowa (UI). She directs the Music Perception Project for the Iowa Cochlear Implant Clinical Research Center, and directs graduate studies for the Music Therapy Program at the UI School of Music. Contact her at kay-gfeller@uiowa.edu.

Without musical training, most listeners with normal hearing can easily recognize commonly heard tunes such as “Happy Birthday” or “The Star-Spangled Banner.” Yet for CI recipients, this recognition isn’t an easy task. CI users may not perceive a monotonic relationship between frequency and pitch; they may experience pitch reversals or hear sensations that are not distinct musical tones. Melodies may sound monotonal, compressed, or distinctly different from the actual melodic contour.

A CI user who can recognize music with lyrics may not recognize the same song without lyrics (Gfeller et al., 2008). Use of lyrics can help CI recipients compensate for poor pitch and melody perception and can improve song recognition considerably when the lyrics contain familiar vocabulary and the words are clearly articulated. Even a few familiar words in the lyrics can trigger associations, which can help the brain piece together the components of a song. The lyrics along with rhythmic cues can provide an auditory “guiderail” to help CI recipients get more meaning out of music, but this advantage is lost if instrumental accompaniment masks the lyrics.

How does this understanding of the role of lyrics translate into everyday listening situations? When engaging young CI recipients in nursery songs, such as “Twinkle, Twinkle, Little Star” or “London Bridge,” lyrics will be easier to extract from a live singer’s voice (combined with speech reading) than from recordings of nursery songs that may have a brisk tempo and complex accompaniment. When listening to music over the radio or stereo, CI recipients can increase their ability to hear song lyrics by turning down the bass volume to reduce the masking of the vocals. Understanding can also be enhanced by following lyrics on the album cover or on Web sites.

Music as Background Noise

Music is often used to create a pleasant social ambience. Unfortunately, this social convention can become the equivalent of background noise for implant recipients. When music impedes conversation, it fits a general definition of noise as any unwanted sound. Musical pieces with a wide frequency range are especially potent in masking conversations—perhaps to a greater extent than background conversation.

I remember participating in a self-help workshop organized by and for CI recipients at a hotel conference center. The conference presentations featured excellent information about how to get the most out of a CI. However, there was obtrusive background music at almost every coffee break, meal, or social event. I vividly recall the strained faces of CI recipients who shouted over the music to communicate—a task made even more difficult by dim lighting. This event was expressly for CI recipients, yet it was “business as usual” when it came to the social conventions of ambient music and soft lighting that hinder communication. Perhaps program organizers fell back on old habits of social conventions—what’s a party without music? Or perhaps music was part of the normal hotel ambience, and no one had thought to request a modified acoustic environment.

We can’t always control acoustic environments, but with advance planning, favorable listening conditions often can be created. We can encourage CI recipients and their families to avoid playing background music when planning social gatherings. CI recipients should be encouraged to consider listening to music and conversation as two separate events; combining them can compromise the enjoyment of both.

Residual Hearing to Enhance Music Perception

CI recipients have poorer word recognition in noisy listening environments than in quiet conditions (Turner et al., 2004; Kong et al., 2004, 2005). The lack of low-frequency

information through CI signal processing contributes to poor speech recognition in noise and is also problematic for perception and enjoyment of pitch, melody, and timbre.

Research indicates that bimodal stimulation (CIs plus ipsilateral and/or contralateral hearing aids) is associated with improved music perception and enjoyment as well as with enhanced speech recognition in noise (Gfeller et al., 2008; Kong et al., 2005; Looi, 2008; Turner et al., 2004). Even a modest amount of preserved residual hearing optimized with hearing aids can convey low-frequency information that enhances melody recognition with a more natural tone quality. The advantage of preserved residual hearing for music is a factor to consider when testing and counseling patients on the use of hearing aids in conjunction with their CI and on the pros and cons of bilateral implantation.

In the conversation between Jana and the Jamesons, who are considering a cochlear implant for their son, Jana must provide realistic expectations regarding the likely benefits of CIs for speech perception as well as some drawbacks for perception of musical pitch and tone quality. However, the benefit of the CI for speech in background noise and music perception can be improved by thoughtful approaches to listening. Although music may no longer sound “normal,” recognition of songs can be optimized by attending to the lyrics, which may provide enough contextual cues to trigger a meaningful mental representation of the music. In addition, CI recipients can be encouraged to control their conversational environments by eliminating background music, which can mask conversation.

Finally, audiologists can explore with their clients the benefits of preserving acoustic hearing, and the potential synergistic effects of bimodal stimulation to enhance music perception and enjoyment as well as speech perception in background noise.

References

- Gfeller K, Oleson J, Knutson J, Breheny P, Driscoll V, Olszewski C. Multivariate Predictors of Music Perception and Appraisal by Adult Cochlear Implant Users. *Journal of the American Academy of Audiology*. 2008; 19:120–134. [PubMed: 18669126]
- Kong Y, Cruz R, Jones J, Zeng F. Music perception with temporal cues in acoustic and electric hearing. *Ear & Hearing*. 2004; 25:173–185. [PubMed: 15064662]
- Kong Y, Stickney G, Zeng F. Speech and melody recognition in binaurally combined acoustic and electric hearing. *Journal of the Acoustical Society of America*. 2005; 117:1351–1361. [PubMed: 15807023]
- Looi V. The effect of cochlear implantation on music perception. *Otorinolaryngologia*. 2008; 58:169–190.
- Turner CW, Gantz BJ, Vidal C, Behrens A, Henry BA. Speech recognition in noise for cochlear implant listeners: Benefits of residual acoustic hearing. *Journal of the Acoustical Society of America*. 2004; 115:17–1735.
- Wilson, B. Cochlear implant technology. In: Kirk, KI.; Niparko, JK.; Mellon, NK.; Robbins, AM.; Tucci, DL.; Wilson, BS., editors. *Cochlear implants: Principles and practices*. Lippincott, Williams & Wilkins; New York: 2000. p. 109-118.