



Music and Implants Piecing the Puzzle Together

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Though cochlear implants (CI) are designed primarily for the transmission of sounds related to speech, many CI recipients are successfully enjoying the sounds of music.

Solving the puzzle of why some CI recipients successfully enjoy music, involves considering each recipient's biological, environmental and lifestyle characteristics.

Although there are pieces still missing when it comes to understanding the interaction between music perception and cochlear implants, some parts of the puzzle are already in place. There are strategies for optimizing a recipient's experience with music.

Cochlear implants were designed primarily to help people understand speech, and most CI recipients achieve wonderful benefit for speech perception, especially in quiet. Although speech and music share some acoustic characteristics, there are also important differences. It is much easier to transmit through current CI technology those parts of speech essential to

understanding than those parts of music that help us to recognize melodies. In particular, pitch and tone quality, both very important in music, are challenging to convey through current implant technology. You might compare different kinds of sounds to the different blades in a food processor. Some blades are just great for chopping, others for slicing or dicing, still others for pureeing. One blade cannot do it all. Today's implants are best suited for transmitting words rather than melodies, but with practice, trial and error and ever-evolving technology, recipients can develop new tools for hearing and enjoying music.

One of the most important aspects of music enjoyment is establishing realistic expectations: Chances are, music may not sound like it did prior to a person's

hearing loss. But with the right approach a great many CI recipients can have a positive music experience. Several factors contribute to the successful enjoyment of music.

Biological Factors: Biological differences are one piece of the puzzle. CI recipients are not alike in terms of their hearing history and the status of their hearing mechanism (cochlea, auditory nerve, central nervous system). Some people have a clear cochlear structure that allows the surgeon to achieve a full insertion of the electrode, while others have a more unique anatomy that makes a full insertion difficult. Some CI

Continued on pg. 2

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recipients have been deaf for many years, others for only a short time. Some may have become deaf as a result of a disease that did extensive damage to the nerve cells, while others may retain some residual hearing. There can also be variations within a person's cochlea, so that there might be more residual hearing for high-, medium- or low-pitched sounds. We believe that the insertion, as well as the extent of remaining nerve cells and residual hearing, can make a difference in how effectively the CI transmits both speech and musical sounds. Understanding that fact can help explain why one person's perception of music may be very different from that of another user who has a similar device.

All music is not created equal: Just as CI recipients may find some speakers easier to understand than others (e.g., men versus women, versus children, etc.), some parts of music and some styles of music are more effectively transmitted through the CI. Specifically, the CI is very good at transmitting the rhythm or beat of music. As a result, many implant recipients enjoy country line or ballroom dancing after implantation because these activities rely most heavily on the musical beat. In addition, the kinds of music that have a strong beat, such as rock or rap, may be more easily deciphered compared to more lyrical music that emphasizes melodic qualities.

Since the CI was originally designed to transmit speech, many recipients are more successful at recognizing the lyrics of a song, especially if the song is

familiar to them and if the accompaniment is relatively soft. Some recipients find it extremely helpful to follow the lyrics on a CD or record jacket while listening. Some may also find it helpful to read the lips of the singer on TV or in live performances.

CIs are also somewhat effective at transmitting timbre, or tone quality. For example, many CI recipients can hear a difference between the sound of a piano and the sound of a saxophone even if they find the tone odd or unpleasant.

At present, the biggest problem for music perception and enjoyment is hearing individual notes and melodies. Current technology is not well suited for transmitting musical pitch, or detecting whether one note is higher or lower than another. Some CI recipients do amazingly well and can hear some of the melodic contour (the sound of notes going higher and lower) of songs, but many recipients find melody recognition very challenging.

Specifically, the Cochlear implant is very good at transmitting the rhythm or beat of music.

Listening conditions and realistic expectations: Just as speech perception is easier in a good listening environment (no background noise, limited echo, etc.), CI recipients have a better chance of making headway in music listening if they avoid music played at loud volume (which can distort the sound) or listening situations with a lot of echo or competing noise. Some of the more satisfied music listeners are those recipients who acknowledge that music doesn't sound just like it did before their hearing loss, but they have learned to enjoy music in a new way. Or they have found several types of music or listening situations that work for them. Keep in mind that even people with normal hearing enjoy some music more than others. It simply isn't realistic to enjoy all music.

Practice Practice Practice: The good news is that some CI recipients have reported improvement in sound quality as a result of dedicated practice in listening to music, especially music that was familiar prior to hearing loss. Why? Because the brain and its memory of the sound of music prior to hearing loss can help fill in the missing information.

Some recipients have improved their musical enjoyment by focusing more on the rhythm of music, by listening to familiar songs, and through trial and error – selecting specific songs that they personally find better than others through their CI. For example, music by a solo singer with a quiet guitar and drum

accompaniment and with a clear and simple beat, may sound better than symphonic music that has no lyrics and several complex melodies played simultaneously by many instruments.

Many CI recipients have found it possible to establish more realistic expectations, and to even improve their perceptual accuracy and enjoyment.

Those CI recipients who seem to have the best music perception not only have some good luck in terms of their hearing mechanism, but also have put effort into training their brains to hear music. Practice is more than playing music in the background while doing other things. A list of practical suggestions for improving the music listening experience appears below. These are suggestions gleaned from conversations with many CI recipients, as well as from research on systematic training. The training process may need to be a little different for adult and pediatric recipients. Adult recipients can compare music to memories of music through their residual hearing, but implanted children have always heard music through a device designed to transmit speech. The adults can use memories of music to help understand what they are hearing. On the other hand, children who have always heard music through an implant may be less critical of the sound quality. After all, to them, music through their implant is music.

In summary, while it is very hard not to compare progress and benefits between CI recipients, it is important to realize that there are many factors that make a difference in how much a person may enjoy music. Many CI recipients have found it possible to establish more realistic expectations, and to even improve their perceptual accuracy and enjoyment. Trial and error and practice are two of the keys to greater musical enjoyment. And happily, the design engineers are working very hard to seek new approaches to signal processing that may bring musical enjoyment closer for more recipients. In addition, don't forget that music is more than a bunch of notes strung together. Many people enjoy the process of dressing up for a concert, or going country line dancing with friends, or seeing the look of pride on their grandchild's face after their piano recital. Sharing the social connection of music with others is as important as having perfect sound! 🎵

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A Cochlear Music Profile: Lost and Found

Richard Reed doesn't just love music, he lives it. For much of his life, music has been a constant presence and passion.

He has played Hammond organ and piano with a number of rock and roll blues bands, including Jr. Walker and the All Stars, Roomful of Blues, The Schemers, Duke Robillard and Ronnie Earl.

A musician and artist in South Kingstown, Rhode Island, Richard lived for 35 years with normal hearing. But in the early 1990s, he lost his hearing to ototoxic antibiotics.

As his hearing rapidly deteriorated, Richard was fitted with ever more powerful hearing aids. Slowly, Richard became unable to enjoy music at all.

Although he knew he was a candidate for a cochlear implant, Richard was put off by misinformation and the idea of losing residual hearing. But eventually, he met people who offered honest, candid information about cochlear implants.

"There were a lot of music fans out there, and even some classically-trained late-deafened musicians, who wore CIs," he says. But I was hesitant. Not being able to converse with my niece once she started talking was the final straw. So I finally moved forward."

In 2002, Richard received the Nucleus® 24 Contour™. While he soon noticed significant enhancement in his ability to hear and understand speech, music through the implant was disappointing. "For quite a while after my activation, music sounded odd," he says. He wondered if that was as good as it was going to get; but with patience and practice, music improved to the point where songs feel and sound great again.

In the early days of his cochlear implant experience, piano sounded so far out of tune that Richard stayed away from it completely. "It was as if someone had pulled all the keys off and put them back in the wrong places."



ESPr™ 3G (left)
Nucleus® Freedom™ (right)

It was back to basics for Richard, starting with: Do-Re-Mi. From there, he began to make progress and even started playing with bands again.

"As I started playing gigs again, it was hard to hear my own parts within the distorted din." If I turned the piano up, the distortion got worse. A simple fix was having a softer MAP put in program 2 on my ESPrit™3G with the master volume lower than it what would be good for everyday speech, but not so low that I couldn't converse between songs. Other than that, I mostly just needed to get used to it."

Richard read that music perception could improve by trying simple familiar songs. He tried several different songs that he remembered. After many frustrating early attempts at listening, he rediscovered Bob Dylan's "Blood on the Tracks" CD, particularly the song "Lily, Rosemary and the Jack of Hearts." "I put it in the CD player, pushed the start button and was immediately tempted to hit stop. Dylan's wailing harmonica was way too much information for my still-new ear. I turned it down, kept listening and got past that part. The melody wasn't easy to hear, but I could tell what he was singing about. It told a story, which helped me stay interested."

Richard looked up the lyrics on the Internet and read through all the words he couldn't understand. Then he played the song over and over.

"I must have listened to it fifty times over the next two weeks, and at least once a week since. It might not work for anyone else, but was a musical CI epiphany for me."

Soon, Richard was enjoying his favorites again, including early basic rock & roll, Frank Sinatra, Johnny Cash, and many R&B and blues, and pop bands that had disappeared from his ears.

"A lot of them started sounding as good as they felt. In a word – wow."

Once again able to enjoy, listen to and play music both live and in the studio, Richard is an independent advocate for the hard of hearing (HOH) and CI communities. Recipient of the 2003 Helen Kurtzer-White Traveling Fellowship, Richard attended the International Federation of the HOH in Helsinki Finland, and has recently been awarded a full scholarship to Gallaudet University's Certification in Peer Mentoring Program.

"A lot of them started sounding as good as they felt. In a word – wow."



Practical Tips for Music Listening

These suggestions may help recipients to optimize their music listening experience. They may find that some or all are helpful in increasing their enjoyment of music.

1. Choose the listening environment carefully.

- Music will generally sound more pleasant in a quiet room without echo.
- Some people like to use earphones or direct connection to the CI sound processor. Other people prefer using speakers. Whatever your choice, use sound equipment of good quality.

2. Choose music selections carefully.

- Music that was familiar prior to hearing loss can be easier to understand. The brain can help make up for the missing information.
- Start by listening to music played by fewer instruments, such as solos or small ensembles, rather than music played by large bands or orchestras.
- Songs that have many repetitions of musical patterns or words can be easier to understand. Some CI recipients report that children's music can be good listening practice for adults as well as for kids.
- Find out which musical sounds, instruments and styles are most pleasant through trial and error.

3. Be strategic and realistic about listening.

- Listening practice should be broken up into short, but frequent sessions. Brief practices distributed over time can be much more effective than one or two long practice sessions. Start out by simply paying attention to the rhythm, and then gradually focus attention on other aspects. This will gradually build tolerance for different musical sounds.
- Don't expect things to sound great immediately. Many people report that music sounds better the more they listen to it over time.
- If you hear music that sounds really nice, find out what it is, and write down the title. Develop your own CI-friendly listening library.
- Consider enrolling in structured "music therapy" or a music-training program.

4. Make the sound as good as possible.

- Keep the volume at a moderate level.
- Some people find that digital music recording formats, such as CDs, MP3s and other digital music players are easier to understand.

5. Use visual input to help out your ears and brain.

- Use visual cues, such as watching the singer's lips or the rhythmic action of the piano player's fingers, to help make sense of the music.
- Read along with the lyrics, some of which can be found on the Internet.

6. Broaden your music listening goals.

- Remember that music is more than just notes. It is a social activity that brings people together. You can enjoy the planning and preparation of a music event, and focus on the social aspect.
- If you are attending a musical social event and you become overwhelmed, think about taking a silence break. Turn down/off your processor (or even walk out to the lobby or restroom) to clear your ears and your head until you are 'ready' for more listening.
- Be proactive about your listening environment. For example, when making a reservation at a restaurant, ask to be seated away from loud speakers so background music doesn't become your conversational enemy.
- Some people have found listening to vocal music a challenging and interesting way to improve their speech perception. **Give it a try!**

Resources for Enhancing Musical Enjoyment

For Adults:

1. Gfeller KE., Mehr M, Witt S. Aural rehabilitation of music perception and enjoyment of adult cochlear implant users. *Journal of the Academy for Rehabilitative Audiology.* 2001;34:17-27.
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For children:

1. Masia M, Sena K, Kruse J, Olszewski C, Gfeller KE. Music enjoyment and participation for children with implants. *Contact.* 2002;15(1-2):11-14.
2. Gfeller KE. Accommodating children who use cochlear implants in the music therapy or educational setting. *Music Therapy Perspectives.* 2000;18(2):122-130.

Suggestions for Parents of Pediatric CI Users



Try these tips to help pediatric recipients maximize their music-listening experience.

- See how the child responds to different kinds of music. If (s)he seems to enjoy some instruments or musical activities, then encourage participation or informal listening. Keep in mind that many children with normal hearing choose soccer over violin lessons, so it is not a total disaster if music is not your child's cup of tea.
- Remember that some musical activities tend to be more difficult than others for CI users. For example, singing in tune with others or tuning an instrument can be difficult, while moving to the beat in dance or playing a percussion instrument are much easier. In general, trial and error can determine which music activities are most satisfying for the child.
- Loud music may be physically uncomfortable for many CI recipients. A few practical articles that can help in educational accommodations for children in music classes are referenced in the Resources section.
- Let the music teacher know about the child's implant, and share with them practical information about CIs and music. In some cases, music class may not be the best choice, but don't presume that music can't work. Many kids with CIs do participate successfully in some types of music activities.





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