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How We Do It: Adaptation of Music Instruction for Pediatric Cochlear Implant Recipients

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Introduction

In recent years, many pediatric Cochlear Implant (CI) recipients have made great strides in speech recognition, speech production, and language development (e.g., Robbins, 2009). Consequently, families of pediatric CI recipients are now increasingly hopeful that implant benefits will expand to include music participation and enjoyment (Gfeller, 2009). Parents may ask audiologists questions such as: Will my child enjoy music through his implant? Can my child succeed in music lessons? These questions may sound simple enough, but are actually quite complex, in part because the word ‘music’ encompasses a vast range of sounds and response tasks.

Because music heard through CIs sounds significantly different from music heard through a “normal” ear (especially pitch and timbre), successful participation in music is more likely if a music teacher understands the technical limitations of the CI, is sensitive to the unique capabilities and limitations of each child, and is flexible regarding instructional approaches (Gfeller, 2000). This paper integrates information from various disciplinary specialties into a practical and consolidated resource useful to clinicians, educators, and parents in supporting the musical participation of pediatric CI recipients.

There are many instructional programs (e.g., adopting ORFF, Kodaly, Dalcroze, Suzuki, and YAMAHA methods) available for developing music skills in young children. These programs employ developmentally appropriate materials, multi-dimensional musical experiences, cooperative learning environments, and multisensory input. The following sections describe common curricular components that present structural features of music. The implications for perceptual and music production skills will also be discussed.

A systematic analysis of structured music programs

Many music programs for young children typically include all or part of the following basic curricular components: a) ear training, b) singing, c) piano keyboard, d) rhythm ensemble, and e) music appreciation.

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Ear training: Aural skills

Ear training is a term referring to practice in the awareness, discrimination, and comprehension of musical elements. This includes listening to patterns of pitch, rhythm, and chords (harmony). Because CIs provide poor pitch resolution and atypical timbral quality, the intensive aural skills requirements of ear training can present significant challenges for many pediatric CI recipients. A small proportion of implanted children may be able to distinguish intervals as small as a semitone across portions of their listening range, while many may be unable to detect changes smaller than 3 to 8 semitones (Gfeller et al., 2007). Some CI recipients may experience pitch reversals, thus a monotonic relationship between frequency and perceived pitch may not exist for these recipients (McDermott, 2004).

At present, group data do not indicate a clear superiority for any of the CI internal devices, strategies, or settings with regard to music perception or sound quality. Signal processing is still quite limited compared to “normal” hearing with regard to the transmission of fine structure (which is important for pitch and timbre perception). In addition, a damaged peripheral mechanism may have limited capacity to benefit from more fine structure in the signal processing. Some individuals do prefer one setting over another, however. Consequently, trial and error may be useful in identifying the best options for each CI recipient.

Music instructors and parents should understand that aural limitations for pitch perception are related to the characteristics of the CI and do not reflect lack of effort or intelligence on the part of the child. Some accommodations in instructional objectives (e.g., larger intervals or more modest outcomes) for this aspect of the curriculum can help a CI user to participate successfully in music.

Singing: Vocal skills

Vocal skills include singing melodies, as well as songs with lyrics. The primary input includes pitch and lyrics. Visual representations (e.g., notation or written words) can support the development of vocal skills. Because singing in tune to an external pitch is extremely challenging for many CI recipients, this component of the curriculum may be unsuccessful without major accommodations. However, keep in mind that many children with normal hearing are not completely accurate in singing melodic patterns until around age ten (Campbell, & Scott-Kassner, 2005). Thus, as long as the teacher is willing to overlook pitch irregularities or melodic errors during singing, vocal skill development can be a beneficial activity. Singing melodies and song lyrics provides practice in creating melodic contours (relevant to prosody in speech), suprasegmental features (e.g., duration and stress), and production of speech sounds and vocabulary. Some CI recipients have improved tuneful singing as a result of special training. However, if singing proves to be quite frustrating, alternatives such as playing instruments in accompaniment may work well. Individual goals should be set depending upon the profile of each child.

Keyboard (piano)

The keyboard component of the curricula involves playing melodies with and without harmony. Because of the parameters of the frequency bands in the CI's signal processor, the CI will not encode the fundamental frequencies across the entire range of the piano keyboard. Oftentimes, the CI MAP does not transmit the fundamental frequency of notes much below middle C (250Hz). Therefore, some of the lower keys on the piano may sound like a mechanical click to CI recipients, or only the upper harmonics of some notes may be audible. In addition, each electrode in the internal CI array may be stimulated by more than one note on the piano, or may be spread across electrodes. Thus, pitch resolution can be problematic. Despite these limitations, anecdotal evidence and survey data (Gfeller et al.,

2000) indicate that some CI recipients have been very successful in learning to play the piano.

A keyboard instrument may be preferable to string, wind, or brass instruments for CI users because the keyboard provides a constant pitch that does not require ongoing tuning, as well as visual and kinesthetic representation of pitches, intervals, and chords. Thus, CI recipients can check auditory perceptions against visual and kinesthetic cues. As a result of experience playing and listening to the keyboard, some CI recipients have improved their perceptual acuity for the isolated pitches in a music scale (Yucel, 2009).

Rhythm ensemble: Instrument playing

The rhythm ensemble exposes children to diverse rhythmic patterns and the timbre of different percussion instruments (e.g., tambourine or castanets). CIs support good rhythm perception. Furthermore, playing rhythm instruments or moving to rhythm provides ample visual cues; thus, CI users may be quite successful with this component of the curriculum. The primary accommodation that might be necessary is initial presentation of material at a slightly slower tempo.

Music appreciation

Well-known classical excerpts with descriptive themes are often chosen for music appreciation. Through listening, children learn musical form, structure, rhythm, melody, phrasing, timbre, dynamics, and expression. These aural skills require perception and organization of complex and diverse sound patterns. With additional support from graphic illustrations and story lines, teachers and parents can pinpoint specific music elements and characteristics for careful attention. Some children may benefit from cues to attend to unique rhythms or timbral blends, which are more accessible through CIs.

Table 1 provides an overview of the sub-skills found within each of these curricular components, along with the primary types of input required for each component and a general estimate (based upon available research studies) of the difficulty of this type of musical task for many CI recipients.

Conclusion

This paper has outlined the skills required for participation in structured music programs and possible adaptations to facilitate successful participation by CI recipients. Audiologists or speech-language pathologists may hold a key role in helping a music teacher to modify the curriculum or instructional methods by explaining the technical features of the CI and how it influences the child's perception of musical sounds. This can help music instructors to establish more realistic expectations. With some flexibility and trial and error, the child should be able to "fit" into the instructional environment in a satisfactory manner.

In some cases, a child may be integrated more easily into group lessons with supplemental individualized tutoring and dynamic assessment by a music therapist or music teacher who can evaluate the suitability of various lesson components for a particular child. Some skills may require remediation, as well as extra repetitions and time, to reach a level comparable to that exhibited by normal-hearing peers. Other skills may require accommodation, modified or alternative tasks, or less stringent expectations to allow the child to participate successfully. We have provided in the Appendix a checklist of practical recommendations that can be shared with the music instructor in order to successfully integrate a CI recipient into early childhood music programs.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Primary Types of Sensory Input and Level of Difficulty

Music Skills	Sub-skills	Essential Types of Sensory Input	Difficulty
Aural Skills	Listening to melodic patterns (Sequentially and simultaneously)	Pitch	3
	Listening to rhythmic patterns	Rhythm	1
Vocal Skills	Singing melodic patterns	Pitch	3
	Singing songs with lyrics	Lyrics, Pitch	1, 3
Keyboard	Playing single/dual melodic lines, melody + chords	Rhythm, Pitch	1, 3
Percussion Instruments	Playing rhythmic patterns	Timbre, Rhythm	1, 2
Music Appreciation	Learning form, structure, rhythm, melody, phrasing, timbre of different instruments, dynamics, and expression	Timbre, Rhythm, Pitch	1, 2, 3

Difficulty Ratings	Definitions	Types of Input
1	Easy; similar to normal hearing (NH) listeners	Lyrics, Rhythm
2	Significantly different from NH listeners; can be trained	Timbre
3	Most difficult; limited change with training	Pitch