



# Tools for Schools™

Helping children with cochlear implants  
succeed in the classroom

Winter 2007 Issue 4

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## Feature Article

### Using Normal Developmental Milestones with Children who have Cochlear Implants

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When cochlear implants were first approved for children, many people did not foresee that children who were profoundly deaf would one day achieve spoken language skills commensurate with children born with normal hearing. Detection of sound and improved lipreading made recipients and scientists ecstatic, and at the time, that was an amazing feat.

Today, children with cochlear implants often achieve speech, language, and reading skills equal to those of their hearing peers.<sup>1,2,3</sup> These improved outcomes are largely due to advances in technology and early identification and intervention of hearing loss. As a result of these improved outcomes, many professionals base therapy goals for children with cochlear implants on the developmental milestones of children with normal hearing.

Why should we use normal developmental milestones?

1. Children who are deaf have the potential to learn to hear and speak with a cochlear implant.
2. Specific goals can be developed for children with cochlear implants using normal developmental milestones for vocabulary, speech, and language as a guide.
3. Progress can be measured to determine if a child is meeting appropriate milestones.

This issue of the Tools for Schools (TFS) newsletter reviews the listening and speaking milestones for children with normal hearing and discusses how these milestones can guide planning therapy and monitoring performance of children with cochlear implants.

#### **NORMAL DEVELOPMENTAL MILESTONES AS A GUIDE**

Today children one year of age and older are approved for cochlear implantation. Many professionals are uncertain what guidelines to use to measure progress after implantation. The knowledge of normal developmental milestones is easy to access via books and the internet, and is a wonderful guide to monitor progress and start teaching a child to listen.

Normal developmental milestones represent a range of abilities for children of the same age. For example you may have two children, both 15 months of age with normal hearing; one child may

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use 100 spoken words and frequently two-word combinations, while the other child, may only have 10 spoken words. In this example each of these children have spoken language skills within the range of normal development. Likewise, two children with a similar hearing loss and history of intervention may develop very differently. Thus, it is important to recognize a range of progress following a cochlear implant.

### **Begin by Establishing the Child’s “Hearing Age”**

To use normal speech and language milestones to monitor the performance of children who are deaf, you must first establish the child’s hearing age. When a child’s cochlear implant is activated he/she celebrates a hearing birthday, and a “hearing age” is used to indicate the child’s length of time with the cochlear implant. Skill level at the hearing age is compared to the chronological age. When there is a gap between the two ages, therapy goals are set to help the child “close the gap” with the ultimate objective that the implanted child will eventually reach the skill level of his normal hearing peers.

Children one year of age and older are approved for cochlear implantation. The table below, from [www.asha.org](http://www.asha.org), includes listening and speaking milestones for children birth to two years of age with normal hearing and can be useful for assessing the post operative progress of children with cochlear implants.<sup>4</sup>

<b>Hearing and Understanding</b>	<b>Talking</b>
<b>0-3 Months</b> <ul style="list-style-type: none"> <li>Startles to loud sounds.</li> <li>Quiets or smiles when spoken to.</li> <li>Seems to recognize caregiver voice and quiets if crying.</li> <li>Increases or decreases sucking behavior in response to sound.</li> </ul>	<b>0-3 Months</b> <ul style="list-style-type: none"> <li>Makes pleasure sounds (cooing, gooing).</li> <li>Cries differently for different needs.</li> <li>Smiles when sees parent.</li> </ul>
<b>4-6 Months</b> <ul style="list-style-type: none"> <li>Moves eyes in direction of sounds.</li> <li>Responds to changes in tone of your voice.</li> <li>Notices toys that make sounds.</li> <li>Pays attention to music.</li> </ul>	<b>4-6 Months</b> <ul style="list-style-type: none"> <li>Babbling sounds more speech-like with many different sounds, including p, b and m.</li> <li>Vocalizes excitement and displeasure.</li> <li>Makes gurgling sounds when left alone and when playing with you.</li> </ul>
<b>7 Months-1 Year</b> <ul style="list-style-type: none"> <li>Enjoys games like peek-o-boo and pat-a-cake.</li> <li>Turns and looks in direction of sounds.</li> <li>Listens when spoken to.</li> <li>Recognizes words for common items like “cup”, “shoe,” “juice.”</li> <li>Begins to respond to requests (“Come here,” “Want more?”).</li> </ul>	<b>7 Months-1 Year</b> <ul style="list-style-type: none"> <li>Babbling has both long and short groups of sounds such as “tata upup bibibibi.”</li> <li>Uses speech or non-crying sounds to get and keep attention.</li> <li>Imitates different speech sounds.</li> <li>Has 1 or 2 words (bye-bye, dada, mama) although they may not be clear.</li> </ul>
<b>1-2 Years</b> <ul style="list-style-type: none"> <li>Points to a few body parts when asked.</li> <li>Follows simple commands and understands simple questions (“Roll the ball,” “Kiss the baby,” “Where’s your shoe?”).</li> <li>Listens to simple stories, songs, and rhymes.</li> <li>Points to pictures in a book when named.</li> </ul>	<b>1-2 Years</b> <ul style="list-style-type: none"> <li>Says more words every month.</li> <li>Uses some 1-2 word questions (“Where kitty?” “Go bye-bye?” “What’s that?”).</li> <li>Puts 2 words together (“more cookie,” “no juice,” “mommy book”).</li> <li>Uses many different consonant sounds of the beginning of words.</li> </ul>

**[Click here to visit www.asha.org](http://www.asha.org) and link to a complete table which includes the listening and speaking milestones for children over 2 years of age.**<sup>4</sup>



**NOTE:** The first 6-12 months of a child's life (or a deaf child's "hearing" life) are very important for providing the foundation of spoken language. This period of time can be frustrating for parents and teachers who may have expected a very young child to understand and speak soon after activation of a cochlear implant. It is important to keep in mind that a child with normal hearing does not speak immediately following birth, and likewise a very young child with new hearing must have a similar, yet more intense, listening foundation before using spoken language.

### Case Example

Child A is 3.0 years of age. He received a cochlear implant that was activated at 1.0 years of age.

Hearing Age = 2.0 years.

Child A should be able to perform the listening and speaking milestones for children 1-2 years of age as outlined in the table above.

#### Hearing and Understanding

- ✓ Points to a few body parts when asked
- ✓ Follows simple commands and understands simple questions
- ✓ Listens to simple stories, songs, and rhymes
- ✓ Points to pictures in a book when named

#### Talking

- ✓ Says more words every month
- ✓ Uses some 1-2 word questions
- ✓ Puts 2 words together
- ✓ Uses many different consonant sounds at the beginning of words

In order to "catch up" with hearing peers, Child A will need to progress more quickly than the timelines in the chart. He/she has one year of vocabulary and spoken language abilities to acquire in order to demonstrate levels of performance similar to other 3-year-olds. He/she will require intensive therapy to meet this goal. Specific goals can be developed using normal developmental milestones as a guide in the areas of audition, speech, and language.

### Therapy Planning

Each therapy session should contain goals and activities related to each area of development: Audition, Cognition, Speech, Language and Vocabulary, as well as activities parents can do with their children to reinforce the concepts learned in therapy.

#### Auditory Goals

Listening skills develop in a hierarchy and most children born with normal hearing progress through the listening hierarchy with great ease. With use of appropriate technology and intervention, deaf children are now also able to progress through the stages in the hierarchy.



Detection of sound is the prerequisite skill required to learn to listen. After a child has developed consistent responses to sound he/she can begin to progress through the levels of auditory skill development and eventually process more complex information. Discrimination is the ability to determine if sounds are the same or different. This step does not typically require formal teaching, but may be focused on in therapy when a child is experiencing difficulty discriminating sounds that are very similar, or differ by one feature (e.g. fat versus flat). The identification of sound is when a child can

reproduce the sound or word that he heard (e.g. imitating the Ling 6 sounds). **[Click here to link to the TFS's Ling picture and instruction card.](#)** The highest level of auditory skill development is comprehension, which includes following multi-element directions and participating in conversation.

With this hierarchy in mind, activities can be developed according to each of these levels of auditory skill development, regardless of the age of the child. Often, listening activities are included in each session at a sound awareness level, a phoneme level, a sentence level, and discourse levels. Every child will not progress through the hierarchy at the same rate, and specific timelines will not apply to every child. It is critical, however, to develop specific short-term and long-term goals for each child starting from the beginning of the hierarchy in developing listening and speaking skills.<sup>5,6</sup> It is also important to note that the levels are not independent of one another. Activities in a session may be related to one or even all the levels, depending on the skill of the child. For instance, in an activity addressing comprehension of information, such as following 3-step directions, a clinician may notice a child is confusing some of the words. In that instance the clinician might address the identification level by asking the child to repeat what he heard, to determine where he is experiencing difficulty.

***Below is a table which includes some examples of activities that may be included at each level of the auditory hierarchy<sup>6</sup>***

### **Hierarchy of Listening Skills**

Adapted from Figure 4.1, Estabrooks, W. (Ed.) 2006. Auditory-Verbal Therapy Theory and Practice, p. 78.

#### **Detection**

- Conditioned play response
- Spontaneous alerting response

#### **Discrimination**

- Same/different tasks
  - One, two, three-syllable word discrimination
  - Minimal pair discrimination

#### **Identification**

- Suprasegmentals
  - Prosodic features of speech
  - Loudness and pitch
  - Angry and sad voices
  - Male, female, and children's voices
- Segmentals
  - Initial "sound" vocabulary
  - Words varying in number of syllables
- Words in which the vowel is constant and the consonants contrast in manner, place, and voicing
- Two critical elements in a message
- Auditory monitoring of segmentals

#### **Comprehension**

- Familiar expressions/common phrases
- Single directions/two directions
- Classroom instructions
- Sequencing 3 or more directions
- Sequencing three events in a story
- Answering questions about a story: closed set and open set
- Comprehension activities/exercises in noisy environments

\*\*It is important to note that children with cochlear implants may not need formal teaching of each goal at each level due to advances in cochlear implant sound processing. Often children do not require formal training at the Discrimination level.

### **Cognition, Speech, and Language Goals**

Additional activities should be included in the therapy sessions to enhance cognitive, speech, and language skills. All goals are based on chronological age and abilities. Cognitive goals may include tasks such as sequencing, and matching shapes and colors. Speech goals may include input and/or production of a particular developmentally-appropriate sound or

sound patterns. Language goals can include input and/or use of prepositions, pronouns, or plurals. Vocabulary goals are also necessary for expanding the child's overall spoken communication skills. Use of the chart below can be helpful for establishing specific goals for acquiring new vocabulary.

#### Rate of Vocabulary Acquisition<sup>8,9</sup>

12 months	First expressive word appears
18 months	20-100 words
24 months	300 words
36 months	900 words
48 months	1500 words
60 months	2500 words

#### **Case Example**

This information can be used to establish specific vocabulary goals for Child A.

Vocabulary age = 2 years old (300 expressive words)

Chronological Age = 3 years old.

To have a 3-year-old vocabulary in one year he/she will have to learn 600 new words, which is approximately 10 new words per week ( $10 \times 52 = 520$ ).

The first few months following cochlear implant activation will consist of providing clear and consistent input of speech and language targets. Once a child begins to produce sounds spontaneously, activities will be centered around the child producing the target sounds or words. Most therapists also incorporate books into each session, particularly if the therapist is using a theme. Each of these areas is targeted with the long-term goal in mind of "closing the gap" between the hearing age and the chronological age.



#### **NOTE**

#### **THERAPY TIPS**

1. Write very specific short-term goals. Example: "Given auditory input, child will learn 10 new words per week. Child will demonstrate comprehension of 2-3 critical elements in a message through audition alone."
2. Therapy sessions are diagnostic, so stay one step ahead of the child's skills (or two!) and be prepared to adjust the activity as needed.
3. Therapy is fun, and functional. Avoid activities the child has mastered in the past, except for review.
4. The parent can be an active participant, not a passive observer. Don't forget to involve mom and dad!
5. Set high expectations for the child from the beginning.
6. Be prepared for the unexpected! When therapy "falls apart" have a bag of tricks to engage the child, such as nail polish or pom-poms, to get the session going.

#### **Monitoring Progress**

Research has indicated that children with cochlear implants are expected to make at least one year of progress each year in speech, language, and vocabulary skills, if there are no additional complicating factors.<sup>10,11</sup> In order to close the gap between hearing age and chronological age, greater than one year of progress must be made each year. By comparing the child's scores at the baseline evaluation to those achieved after several months of therapy, one can determine if appropriate progress has been made. Standardized language and vocabulary measures provide standard scores and age equivalencies that can be helpful when assessing progress.

#### **Standardized Assessment Tools**

It is extremely important that clinicians and teachers routinely evaluate the speech and language skills of children with cochlear implants. The information provided by an objective measure is invaluable for long-term treatment planning and goal-setting. There are several standardized assessment tools that can be used to evaluate a child's speech and articulation skills, expressive and receptive vocabulary, and auditory comprehension. Age equivalents and standard scores

provided by these tests are an excellent way to explain goals and progress to parents and other professionals. A standard score in the average range can be a goal for the child with the cochlear implant to achieve if his/her scores are well below average. Similarly, age equivalents are useful for assessing rate of progress. If a child is to make one year (or more) of progress in a year, the age equivalent can be used to give an approximate timeline for rate of progress toward closing the gap with his chronologic age.

**[Click here for a description of several different standardized assessment tools that can be used to monitor the progress of children with cochlear implants.](#)**

To learn more about using normal developmental milestones as a guide for establishing goals and creating a framework for therapy, access Advanced Bionics free online Webinar Series “Therapy Guideposts”. The webinar consists of 10 courses and includes 4 specific courses dedicated to use of developmental milestones to plan therapy for children of all ages. The series begins March 15, 2007.

**[Click here to for more information and to register for Advanced Bionics’ FREE webinar series “Therapy Guideposts”.](#)**

## Technology Corner

Advanced Bionics, a Boston Scientific Company, is pleased to announce the approval of the Harmony™ HiResolution® Bionic Ear System. Designed to enhance music appreciation and improve hearing in a variety of listening situations, the Harmony system couples revolutionary internal sound processing, (with the optional HiRes Fidelity 120™\*), with the new Harmony behind-the-ear (BTE) external sound processor. Together, the two key components of the Harmony system are designed to provide significantly enhanced spectral resolution compared to conventional systems for a more natural representation of sound. The Harmony system will be available in early 2007.

### **Component One: HiRes Fidelity 120™\***

HiRes Fidelity 120™ delivers 120 spectral bands, designed to increase hearing potential and quality of life for individuals with severe to profound sensorineural hearing loss. The system increases the number of spectral bands from 16 to 120 by actively steering electrical current.

\*In U.S., optional feature for adults only. See package insert for details.

**[Click here to learn more about HiRes Fidelity 120™ Sound Processing.](#)**

### **What are the potential benefits of HiRes Fidelity 120™?**

- Better performance in noise
- Enhanced music appreciation
- Improved incidental learning
- Better performance in difficult listening situations, including classrooms
- More natural representation of sound

**[Click here to learn more about clinical trials results with HiRes Fidelity 120.](#)**

### **Component Two: Harmony™ BTE**

The Harmony BTE was designed to meet the most requested user enhancements as well as support HiRes Fidelity 120.





### **What are the benefits of the Harmony™ BTE?**

- A full work or school day of battery life on a single charge
- Built in tri-color LED for easy system status check
- Naturally placed T-Mic for easy use of the telephone and headphones
- Enhanced comfort with small size earhooks
- Easy access to loop systems through a built in telecoil
- Easy, cost effective access to wireless FM (Phonak MLxS) with iConnect
- A variety of color choices and a sleek headpiece design
- Moisture resistance
- IntelliLink™ a safety feature that prevents accidental stimulation should processors be swapped between students or ears (in the case of bilateral cochlear implants)
- HiResolution® Sound Processing, preferred by over 90% of adult recipients based on reported improvements in sound clarity, ability to hear better in noise, and appreciate music again

## **Resource Corner**

### **SPOTLIGHT ON: The Cottage Acquisition Scales for Listening, Language, and Speech (CASLLS)**

The Cottage Acquisition Scales for Listening, Language, and Speech (CASLLS) were developed by Elizabeth M. Wilkes, Ph.D., CED, CCC-SLP at the Sunshine Cottage School for Deaf Children in San Antonio, TX. These scales are an integrated approach to tracking spoken language progress of young children with hearing loss. The following levels are available: Pre-Verbal, Pre-Sentence, Simple Sentence, Complex Sentence, Sounds and Speech. Each level contains skill development in the areas of listening, language, speech, and cognition. The scales are useful for explaining progress and normal developmental milestones to parents and other professionals. The checklist format is excellent for use in therapy when assessing and targeting a particular skill. CASLLS is used in many areas of the U.S. and is now available in Spanish. The complete test and individual forms are available at [www.sunshinecottage.org](http://www.sunshinecottage.org) and at [www.agbell.org](http://www.agbell.org).

### **Additional Resources**

To learn more about Auditory-Verbal Therapy, cochlear implants, learning to listen, the following Internet resources are available:

[www.bionicear.com](http://www.bionicear.com): Advanced Bionics Corporation hosts recorded and live web classes for teachers and therapists that cover a wide variety of topics for clinicians.

[www.listen-up.org](http://www.listen-up.org): A parent-driven website that contains handouts on auditory development and Auditory-Verbal Therapy and hosts a listserv for parents.

[www.agbell.org](http://www.agbell.org): (see First Years project for detailed course of study). The Alexander Graham Bell Association for the Deaf is an international organization that supports use of spoken language and independence for deaf children and their families, as well as professionals who work with deaf children, and deaf adults. AG Bell hosts conferences for parents and professionals, and online training events. Numerous resources are available at the online bookstore.

[www.learningtolisten.org](http://www.learningtolisten.org): The website of the Learning to Listen foundation in Toronto, Ontario, Canada, contains information about Auditory-Verbal Therapy, professional education, and information regarding current research and publications.

[www.enchantedlearning.com](http://www.enchantedlearning.com): This website contains easy printable activities for all ages that enrich vocabulary and language.

[www.brainpop.com](http://www.brainpop.com): Contains resources for parents and teachers on all subjects for all ages.

[www.school-house-rock.com](http://www.school-house-rock.com): Contains resources for teaching grammar and vocabulary using songs and rhymes and is appropriate for school-age children.

# Upcoming Education and Training Events

## Web Courses

Advanced Bionics offers several live web courses every month. A library of recorded courses is also available. Web courses are free and offer continuing education units (CEUs).

### Upcoming Live Web Courses

#### Webinar Series

#### Date of First Class

Extreme Makeover: Cochlear Implant Edition

January 16, 2007

**Course Description:** This workshop is geared for parents, recipients, educators, audiologists, early intervention specialists, speech language pathologists, therapists, and other allied healthcare professionals. Participants can expect to learn new, innovative teaching and educational methodologies, resources, and therapy ideas in working with children who are severe to profoundly hearing impaired. Additionally, information will be shared on recent trends in cochlear implantation and the clinical management of these children.

**[Click here to register and learn more about Advanced Bionics' webinar series "Extreme Makeover: Cochlear Implant Edition."](#)**

#### Webinar Series

#### Date of First Class

Therapy Guideposts

March 15, 2007

**Course Description:** The Cochlear Implant Journey begins from the moment a hearing loss is identified and a decision is made to receive a cochlear implant (CI). Whether it is a young child or an adult, there will be a series of Therapy Guideposts that are needed to maximize the recipient's success with the CI. This workshop is designed to provide CI recipients, parents, educators, and clinicians with the necessary Guideposts to create a (re)habilitation plan that meets the unique needs of CI recipients so that they may augment their performance outcomes. Additionally, each course will provide resources and materials that participants can use to enhance the (re)habilitation experience with recipients and families.

**[Click here to register and learn more about Advanced Bionics' webinar series "Therapy Guideposts."](#)**

### Recently Recorded Web Courses

**Music to Our Bionic Ears:** The Language of Music, Music and Language, Music Development in CI Kids, Using Music to Foster Daily Living Skills with Hearing Loss. Authors: Amy Robbins and Chris Barton

**Tuesdays with Mary:** Tool Time: Listening Activities for Infants and Toddlers. Author: Mary Koch

**Tuesdays with Mary:** Tool Time: Listening Activities for School Aged Children. Author: Mary Koch

**[Click here to register for Advanced Bionics' FREE web courses.](#)**

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