Chapter 12

Paediatric Aural (Re)Habilitation

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'Excellent listening and spoken language outcomes are probable for children with hearing loss when we do what it takes'

~Mission Probable: Hearing First, 2019

Introduction

Changes in the paediatric hearing healthcare landscape have allowed for unprecedented possibilities and extraordinary outcomes for children with hearing loss (HL). The ability to screen for HL shortly after birth, together with changes in hearing technology, underpin these possibilities and outcomes. There is a wide range of intervention approaches (Figure 12.1) ranging from an only visual mode of communication to a Listening and Spoken Language (LSL) approach.

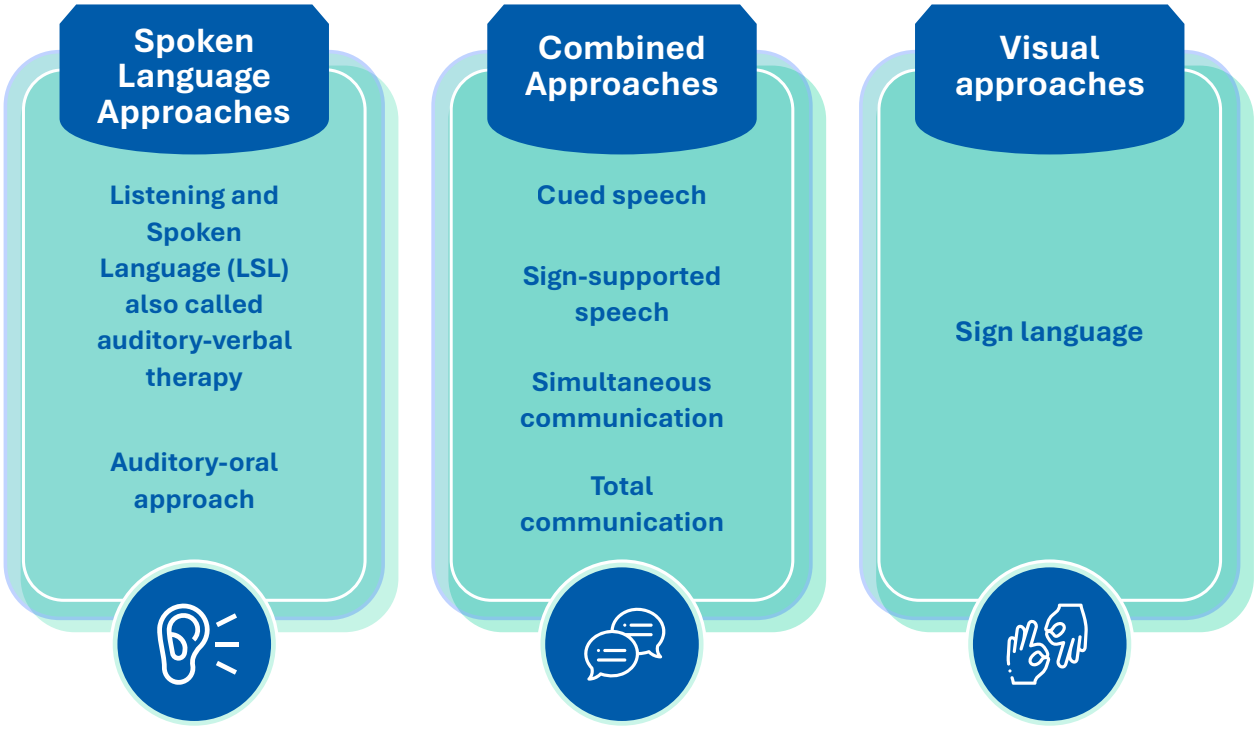


Figure 12.1: Communication approaches from most to least auditory

Within any of these intervention approaches, certain aspects may be more or less feasible for the child or the family, particularly in resource-constrained contexts and when children are identified later than recommended. In many emerging contexts, delayed diagnosis remains common due to the absence of mandated universal newborn hearing screening (NBHS) programmes. At the system level, healthcare services may be limited by constrained access to technology and inconsistent service delivery. In some instances, even after HL has been identified, hearing technologies may not be offered by governments, or the options offered may fall short of current standards of care. At the family level, competing priorities such as meeting basic needs may limit the ability to cover the costs associated with hearing technologies, therapy or travel to services. In addition, services may be unavailable or inaccessible in the family's area of residence across all levels of care. In such contexts, hearing healthcare professionals (HHPs) should strive to promote equity by recognising and responding to the

time, financial and emotional demands placed on families. Where professional-led decision making predominates, careful attention to the principles of informed consent is essential to ensure that each family's autonomy and right to self-actualisation are respected.

Madell and Hewitt (2022) highlight important questions that can be used to guide the decision-making process on which communication approach to follow:

1. What is the family's desired outcome?
2. If the caregivers choose a language with which they are unfamiliar (for example, Sign Language), can they commit to becoming fluent?
3. Will all family members be able to communicate in the selected mode?
4. Will the communication approach allow the child to feel part of the family?
5. Is the selected communication approach appropriate for that particular family and child?
6. Will the child be ready to start school with the selected communication approach?

These questions are intended to support families and professionals in reflecting on how different communication approaches align with the child's needs, the family's goals and the realities of their context. Rather than directing families toward a single option, these questions highlight the importance of informed, values-based decision-making. Regardless of the communication modality chosen, successful language development depends on sustained caregiver commitment, consistent participation and access to appropriate support. Families play a central role in creating rich language environments and their ongoing engagement is a critical determinant of developmental outcomes across all approaches.

Listening and Spoken Language (LSL) approach

This chapter focuses on supporting families who choose a Listening and Spoken Language (LSL) approach and on building a listening brain as the foundation for spoken language and higher-order cognitive skills.

The LSL approach is based on the ten principles of Auditory Verbal Therapy (AVT) (Estabrooks et al. 2016):

1. Promote early diagnosis of HL in newborns, infants, toddlers and young children, followed by immediate audiologic management and AVT.
2. Recommend immediate assessment and use of appropriate, state-of-the-art hearing technology to obtain maximum benefits of auditory stimulation.
3. Guide and coach caregivers to help their child use hearing as the primary sensory modality in developing listening and spoken language.
4. Guide and coach caregivers to become the primary facilitators of their child's listening and spoken language development through active, consistent participation in individualised AVT.
5. Guide and coach caregivers to create environments that support listening for the acquisition of spoken language throughout the child's daily activities.
6. Guide and coach caregivers to help their child integrate listening and spoken language into all aspects of the child's life.
7. Guide and coach caregivers to use natural developmental patterns of audition, speech, language, cognition and communication.
8. Guide and coach caregivers to help their child self-monitor spoken language through listening.
9. Administer ongoing formal and informal diagnostic assessments to develop individualised auditory-verbal treatment plans to monitor progress, and to evaluate the effectiveness of the plans for the child and family.
10. Promote education in regular schools with peers who have typical hearing and with appropriate support services from early childhood onward.

Within the LSL approach, caregivers are acknowledged as the primary agents of change in their child's life. They need to be empowered with skills and strategies that will support developing listening as the foundation for later talking and thinking. HHPs need to be able to support both adult and child learning during each session. The AG Bell Academy in the USA is a non-profit organisation responsible for the certification of LSL professionals. The current gold standard for therapists working within this approach is certification as an LSL Specialist, certified Auditory Verbal Therapist (LSLS Cert.AVT®).

Using an LSL approach requires significant shifts in thinking and practice. Below is an introduction to ten topics that will support this shift.

Starting early changes everything

The LSL approach holds that starting early is fundamental. Starting early means that the 1:3:6 guidelines have been met – having screened, diagnosed, fitted technology and enrolled the family in a supportive, developmental programme with a skilled therapist by the time the baby is six months old. Starting early not only changes everything for the family and infant, it also changes everything for the HHP. Supporting preverbal babies requires HHPs to gain expertise in caregiver guiding and coaching, enabling them to support their child's mastery of the next developmental skill set according to typical developmental norms. The caregiver needs to recognise what their child has mastered across many domains and have the skills and strategies to support the next developmental phase. The HHP needs to be able to guide and coach this process.

Early attachment and preverbal skills that focus on the broader aspects of brain development become important areas of focus in this early stage. Being able to hear during the development of early skills building ensures that listening is part of the neural networks that are maturing in the infant's brain. The earliest role of the HHP is to protect and impact the space between carer and infant. Hearts for Hearing refer to this as 'the heart space'. This space lays the foundation for a secure attachment, warm loving relationship and a regulated brain ready for optimal learning.

The effects of not having access to a coherent language model go beyond clear speech and good language. By starting early, the downstream effects of HL that build over time can be mitigated. When starting early there is more developmental synchrony and less of a 'gap' between chronological age and functional age (Ching et al. 2018).

It's all about the brain

The overall, foundational, neural architecture of the brain is built, primarily, within the first year of life, a critical time during which brain pathways are connecting and interlinking to form neural highways that will support cognitive, emotional and social abilities. Sensory exposure and repetition within a social relationship are what influence the wiring of this intricate connectome. The earlier a baby's brain has access to sound, the more probable the

outcome of spoken language. Conversely, the later a baby has access to sound, the less probable it becomes that functional listening can be wired into the superhighways of the brain. This is referred to as 'the use or lose it' principle. The first three and a half years of life are the critical period for language development and a child needs optimal access to sound for robust spoken language outcomes. The longer the period of hearing deprivation, the greater the chance of cross-modal reorganisation.

Importantly, delayed identification and intervention remain common in many low- and middle-income contexts, and meaningful auditory and language development is still possible when access to sound occurs later in childhood. Children who receive hearing technology or cochlear implants beyond the optimal window may follow different developmental trajectories, often requiring more intensive, prolonged and individualised intervention to support listening and language acquisition. In these cases, progress is more variable, rates of learning may be slower, and expectations must be aligned with the child's hearing age rather than chronological age. Nevertheless, neuroplasticity persists beyond early childhood, and with consistent auditory access, caregiver engagement and skilled intervention, children identified later can continue to develop functional listening and spoken language skills.

Hearing versus listening

There is a difference between hearing and listening. Hearing activates the primary auditory cortex while listening involves more whole-brain work. Listening is trying to understand what one hears. This auditory attention forms the basis of all auditory learning and progresses through a hierarchy of developmental skills discussed earlier. Factors that influence listening include:

- Age at which HL was acquired
- Age of diagnosis
- Cause of HL
- Degree of HL/amount of residual hearing
- Effectiveness of chosen technology to provide full auditory access
- Previous auditory experience

- Presence of other learning challenges
- Health of the child
- Effectiveness of audiological management
- Emotional state of family
- Degree of family involvement
- Skill of the therapist and the emphasis placed on auditory learning
- Skill of the parent
- Learning style of the child and family
- Innate learning potential of the child
- Level of sensory regulation for optimal learning: 'just right' zone

When looking at the ten guiding principles that inform the approach of AVT, six of them begin with 'Guide and Coach the parent' (caregiver). Within the LSL approach, HHPs need to collaborate with the caregiver, acknowledging that both parties bring expertise that ultimately benefits the child. HHP knowledge and experience of typical development and expertise with HL partners with the caregivers knowledge and expertise of their unique child and family. HHPs need to actively include caregivers at every stage and in every session, so that they can observe and practice the skills they need to include in their everyday interactions with their child with HL.

Adults employ a variety of learning styles. These are informed by their world knowledge, life experience, and level of motivation. As coaches, HHPs need to understand adult learning styles so that information and practice is presented in a way that best fits how each caregiver learns. The learning and coaching style of the HHP also impacts the therapy process. HHPs furthermore need to be sensitive to cultural differences that may impact the various relationships in the room: caregiver-child and caregiver-professional. Caregivers need to be motivated to implement changes. Interactions between caregivers and child should always occur in the family's home language.

Learning how to focus on adult learning, while also keenly observing the developmental needs of the child, requires focus and skill from the HHP. Seeking out both knowledge, in the form of courses or qualifications, as well as guidance from a mentor can support growth as a clinician in the LSL approach.

Caregivers need to be empowered and skilled. As Harvard University's Centre on the Developing Child states: a parent can 'provide(s) what nothing else in the world can offer - experiences that are individualised to the child's unique personality style; that build on his or her own interests, capabilities, and initiative; that shape the child's self-awareness; and that stimulate the growth of his or her heart and mind.' (National Scientific Council on the Developing Child 2004).

Listening is the foundation

Many caregivers, when starting intervention with their child with HL, are anxious to know when their child will start to talk. HHPs may fall into the trap of focusing on the production of first words from the very beginning of therapy. It is important to remember that if spoken language is the goal for a child with HL, then the initial focus needs to be on building a listening brain. Hearing is a passive, physiological process. It refers to the automatic detection of sound waves by the ear, which are then sent to the brain. Listening, however, is an active process that involves paying attention, interpreting and understanding the sounds that are heard (Cole and Flexer 2007).

Listening develops over time and follows a well-established auditory hierarchy, beginning with basic awareness of sound and progressing through several stages to reach auditory comprehension (Madell and Hewitt 2022). There are several well-known, evidence-based hierarchies of auditory skill development which can be referenced when working with children with HL:

- The Pollack Hierarchy of Auditory Skills Development
- Auditory Learning Guide
- Functional Listening Index – Paediatric (Shepherd Centre)
- Track a Listening Child
- Cottage Acquisition Scales for Listening, Language and Speech (CASLLS)

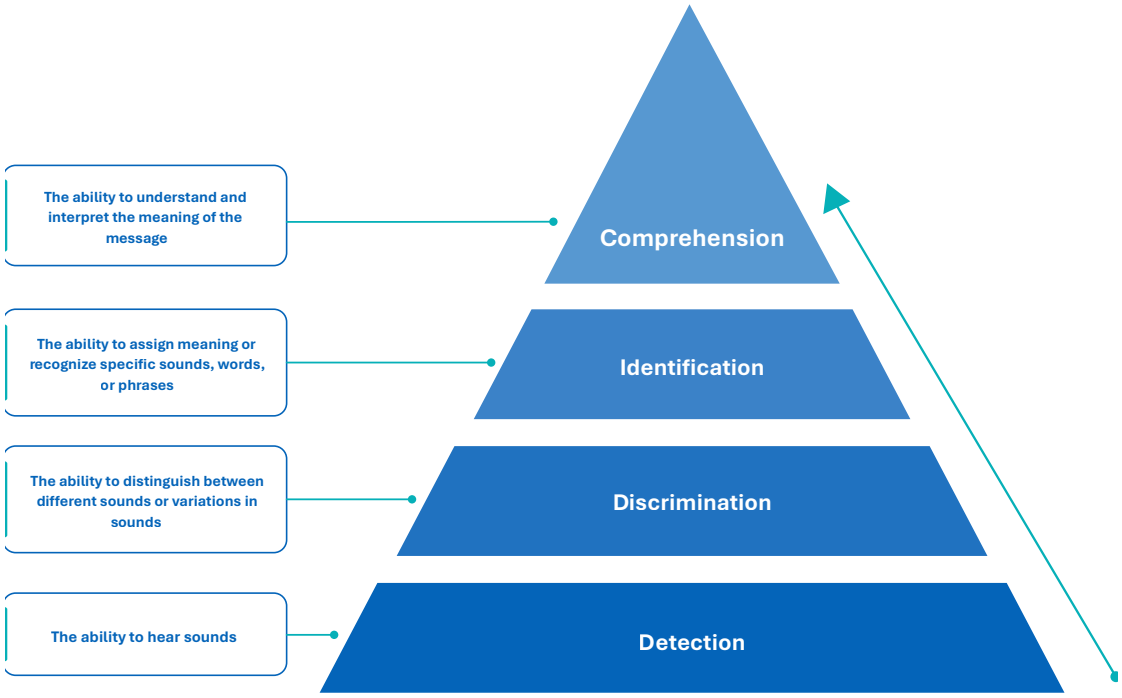


Figure 12.2: Erber's Hierarchy of Listening Skills (adapted from Erber 1982)

Erber's hierarchy (Figure 12.2) starts with basic listening skills and moves towards more complex listening. This framework can guide intervention to ensure a strong listening foundation for all children with HL. Although these auditory skills are set out in a hierarchy moving from basic to complex skills, the development is not strictly linear, with development occurring across levels. It is important seek auditory comprehension from the earliest stage possible.

Before auditory detection skills can be addressed, it is essential that children with HL have access to sound via appropriately fitted hearing technology (Chapters 10 and 11). It is necessary to ensure that the technology provides the child with full access to the speech spectrum at soft levels. The HHP needs to coach and guide caregivers on the importance of day-long listening through hearing technology. One of the first goals in intervention is to ensure the technology is being worn for all waking hours – eyes open, ears on! This sounds like an easy, straightforward process but is often very difficult to achieve. Babies, toddlers and young children are often resistant to something on or in their ears and find the hearing technology very interesting to play. HHPs need to ensure that caregivers understand the vital role that daylong

listening plays in brain development (Gagnon et al. 2021). Prioritising this issue and working on the problem together will help device retention on little ears. Caregivers should be made aware of the many retention options available to ensure that this essential goal is achieved.

Once a child has access to sound through technology, detection of sound can begin. Children need to show awareness of sounds around them, and caregivers need to support the skill of tuning into sounds by talking around their little one. Caregivers need to be coached to provide the child with rich auditory experiences in everyday routines. Babies and young children will show detection of sound in a variety of ways. Initially, a baby might look at their caregiver, stay still or widen their eyes when they hear a sound. Later, they will learn to turn towards a sound (localisation). HHPs should coach caregivers to identify their child's detection responses- These detection responses reflect the beginning of auditory attention.

Without auditory attention, little or no auditory learning can occur. If a child is not responding as expected, further investigation is necessary to evaluate sound access, wear time and the listening quality. It is also important to consider a child's level of sensory regulation, which may contribute to their readiness to listen.

The following activities can be used to facilitate the detection of sound:

- Noisemakers can be used as babies explore different sounds. It is important to connect the sound the toy makes to the toy itself (for example, 'You heard the rattle go shake-shake.'). Noisemakers should be about play and experimenting rather than acting as a constant test from which babies will soon disengage.
- Interesting sounds in the environment can be brought to the child's attention by pointing to one's ear and saying, 'I hear that', showing the child where the sound is coming from and labelling the sound (for example, 'I hear the dog barking woof-woof').
- Ling sounds and Ling-Madell-Hewitt low-mid-high (LMH) sounds can be used during play to determine detection of specific speech sounds, using their technology.
- Learning to Listen sounds (Table 12.1) can be incorporated into play to associate sounds with specific objects. These sounds will capture a baby's listening attention and help build meaning from an early age.
- Songs can be sung to encourage detection of different intonation patterns.
- Parentese (infant-directed speech), with exaggerated vowels, a slower rate and pitch variation, can be used to hold attention.

Table 12.1: Early Learning to Listen sounds

Action sounds	Animal sounds
Crying – waaaaah Sleeping – shhhhh Eating – mmmmmm Smelling – mmmmm	Dog – woof woof Cat – meow Cow – moo Duck – quack quack Mouse – ee ee ee Pig – oink oink Sheep – baa Horse – neigh or tongue clack Lion – roar Monkey – oo aa oo aa
Transport sounds	
Car – brrrm Aeroplane – aaah Ambulance/police – wooooowooowooo Train – choo choo Fire truck – neenaaneenaa *Hooter – beep beep*	

The next auditory level in the hierarchy is discrimination, where the child begins to differentiate between sounds rather than merely detecting their presence. For example, children start discriminating between sounds of different duration, pitch and intensity.

The following activities can be used with babies and young children to facilitate the discrimination of sound:

- Using music to encourage dancing and movement. The child's response to the presence of music versus speech sounds should be observed, for example, they may start moving or clapping in the presence of music.
- Turning music on and off to observe the child's response to the presence or absence of sound.
- Using Learning to Listen sounds that vary in duration, intensity and pitch to encourage discrimination, for example 'ahhhhh' for an aeroplane vs. 'ee-ee-ee' for a mouse.

Auditory identification develops when babies and young children can attach specific, unique meaning to words and sounds. This occurs prior to the ability to follow instructions or answer questions. At this level they also demonstrate the ability to imitate speech sounds. Once a child can associate a sound with a specific object or copy a speech sound, they have mastered the skill of identification.

The following activities can be used to facilitate the identification of sounds:

- Encouraging imitation of the LMH sounds and other Learning to Listen sounds. The HHP or caregiver should wait patiently for the child to take their turn.
- Using pictures or objects with the LMH sounds to see if the child can point to the correct picture when the sound is made.
- Integrating Learning to Listen sounds into daily routines and observing the child's ability to identify the sound-object pair (for example, if you say 'woof-woof', do they point out the dog).

Comprehension develops when children can follow chunks of information, including following instructions, answering questions or retelling a story. From an early age, comprehension is demonstrated through nonverbal responses, such as, blowing a kiss when prompted. It is critical that caregivers and professionals distinguish between auditory and visual responses. Children often use all available sensory input for learning; however, for diagnostic purposes, it is essential to determine whether comprehension is occurring through listening alone.

The following activities can be used to facilitate the comprehension of words and phrases:

- Using the predictability of daily routines to support understanding of common, everyday words and phrases (for example, 'Wave bye bye', 'Clap your hands', 'Hoorah',; 'Blow a kiss', 'Give a cuddle', 'Close your eyes', 'High five', 'Don't touch', 'Wait').
- Linking words and sounds together to capture listening attention and support understanding (for example, 'Let's go up-up-up and down – wheeeeeee'/'Blow a kiss – mwah'/'Give a cuddle – aaah').
- Allowing the context to support understanding in the beginning (for example, nappies always go in the bin, so 'throw it away' is supported by the predictability).
- Using action songs and rhymes daily without providing visual cues. Coaching caregivers to start singing and playing music without any accompanying actions

or movement ensures that an auditory rather than a visual response is observed.

- Sharing a book daily to practice the understanding of labels and routine phrases (for example, 'Turn the page', 'Knock-knock', 'Where's the ___?').

Talking takes time

When a developmental model of intervention is followed, the first words are typically expected after approximately twelve months of listening experience. Focusing on words without adequate listening time sabotages later language development when children need fine listening skills to hear differences in grammatical structures (for example, the difference between [s] or [z] plural markers or a [t] to mark past tense). Time spent building a strong and robust listening foundation supports later language development.

In low-resourced contexts where children with HL are typically identified late, there can be a tendency to prioritise functional language at the expense of good listening. Even when starting late it is important to move through typical development (Madell and Hewitt 2022).

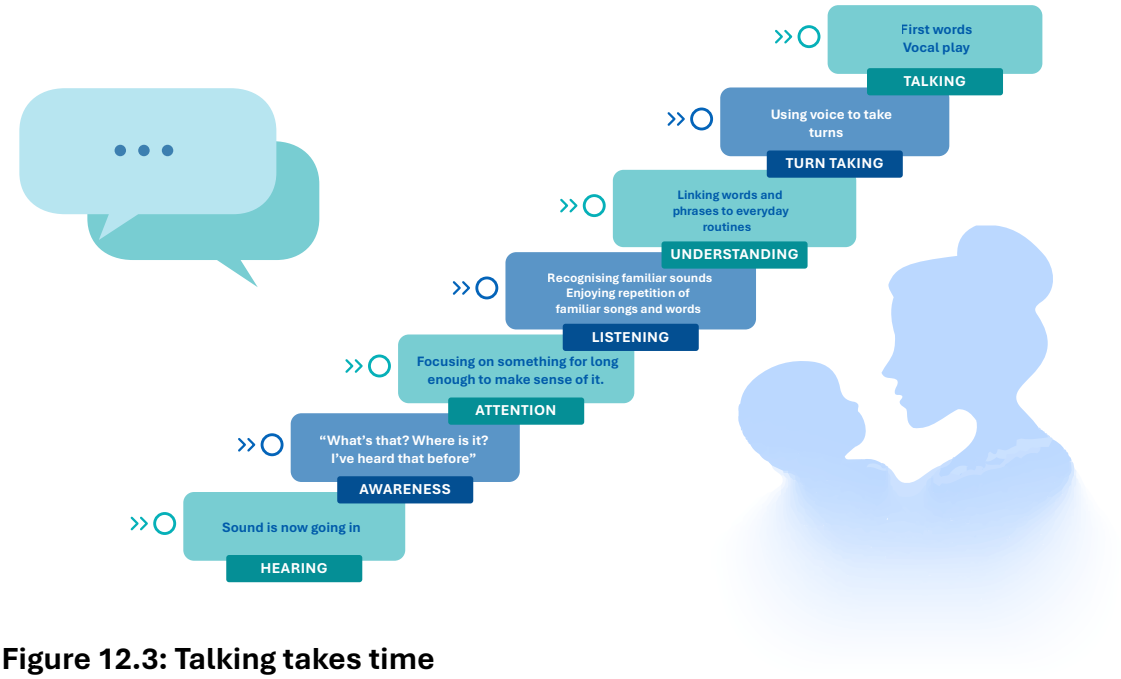


Figure 12.3: Talking takes time

Figure 12.3 highlights the steps from hearing to talking. Each step is necessary to build a rich, robust listening and spoken language system.

Focus on Stage Rather Than Age

In low-resourced contexts where many children may be identified late, a significant discrepancy often exists between their chronological age and their hearing or language age (for example, a five-year-old child with a severe HL who was diagnosed and fitted at four years of age will have a hearing age of one year). Even in high-resourced contexts, it is estimated that 15% to 40% of children are identified outside of the 1:3:6 EDHI guidelines (Madell and Hewitt 2022). Given this discrepancy, intervention should be based on a child's hearing age and current language level. After appropriate hearing technology is provided, the HHP must assess listening, speech and language skills to determine the child's developmental stage. Various free assessment resources are available that are applicable across languages and contexts:

- Functional Listening Index – Paediatric *https://shepherdcentre.org.au/how-we-help/programs-and-services/download-functional-listening-index-paediatric/*
- Integrated Scales of Development *https://www.cochlear.com/au/en/home/ongoing-care-and-support/rehabilitation-resources/scales-of-development*
- A Child's Journey (app) *https://play.google.com/store/apps/details?id=com.medel.childsjourney&hl=en_US&pli=1*

Where available and appropriate, standardised assessments can also be used to determine a child's speech and language level. Recommended tools include:

- Preschool Language Scale 5th edition (PLS-5)
- Clinical Evaluation of Language Fundamentals 5th edition (CELF-5)
- Diagnostic Assessment of Articulation and Phonology (DEAP)

Following a developmental approach ensures that no critical skills are missed and allows for the establishment of a comprehensive listening and language system. When children begin intervention later than ideal, intensive support is necessary to help them progress through developmental stages at an accelerated rate. Rotfleisch and Martindale (2023) identify six developmental stages that can guide intervention:

1. Prelinguistic
2. Singe-word
3. Emerging word combination
4. Communication with child-like errors
5. Competent communicator
6. Advanced communicator

Strategies to Teach Caregivers

LSL specialists aim to coach and guide families in developing their child's listening and spoken language through the implementation of specific strategies (Fickensher, Gaffney and Dickson 2016). A strategy is a specific plan used to achieve a goal. When working with a child with HL, it is essential that the therapist knows and is able to coach specific, evidence-based strategies (Table 12.2). These strategies are intentional methods used to achieve specific goals in auditory development. Although weekly intervention sessions with a skilled therapist are essential for children with HL learning to listen and speak, it is often said that therapy begins as the family leave the session. Caregivers need to be equipped with essential strategies to carry over the therapy targets at home and make them part of their everyday lives. Christina Prodinger and Jayne Simpson Allen from Medel highlight fifteen essential strategies that caregivers need to be taught during the sessions (Med-EL Medical Electronics 2025). Sessions are divided into three broad categories, namely getting ready, listening and talking. Strategy cards can be downloaded at *https://blog.medel.pro/rehabilitation/15-strategies-to-develop-listening-skills-speech-at-home-with-children/*

1. GETTING READY: Strategies to get ready to listen each day:	
1.1 Eyes open, ears on	Ensure that a child's hearing technology is on and in working order during all waking hours.
1.2 Come close to me	Stay close to the child while speaking to them to ensure the best access to sound. This may mean going down to the child's level.

1. GETTING READY: Strategies to get ready to listen each day:	
1.3 Reduce background noise	Make the room as quiet as possible by turning off any background noise.
1.4 Same thinking place	Follow the child's lead and talk about what they are focused on.
2. LISTENING: Strategies to develop a child's listening skills	
2.1 Talk, talk, talk	Narrate life. Talk about what you see, hear, do and think to surround the child with language.
2.2 Acoustic highlighting	Make certain words or phrases stand out using emphasis by speaking softer/louder, pausing, longer or using a different pitch.
2.3 Wait, wait, wait	After asking a question or giving an instruction WAIT to allow the child time to process and respond.
2.4 Auditory hooks	Get the child's attention through listening by using interesting sounds like 'wow', 'ah', 'look'
2.5 Listening first	Give the child information through spoken language first before adding any visual cues or gestures.
2.6 Say it again	Repeat or rephrase part of the message if the child has not heard or understood.

3. TALKING: Strategies to develop a child's spoken language development	
3.1 My voice matters	Recognise every communication attempt and acknowledge every sound or word they make.
3.2 Auditory closure	Use familiar sentences or rhymes and then leave off the last part for the child to complete (for example, 'ready, steady....').
3.3 Expansion and extension	Repeat what the child says but add more information or correct the sentence structure or grammar.
3.4 Use choices	Ask questions with choices so the child can use their language to make decisions.
3.5 Sabotage	Create situations where the child needs to ask for help or to solve a problem.

Monitoring Progress Is a Professional Responsibility

LSL practitioners need to supply regular and ongoing evidence of how the child and caregiver is progressing across a range of skills. This monitoring helps to understand the child and family's rate of learning and identify the level of support needed to master new skills. Knowing progress over time also allows for timely referrals to other professionals if needed. Rossetti's Patterns of Change monitor how the gap between chronological age and functional age is shifting over time: is the gap closing, widening, staying constant or fluctuating? Each interaction with the family provides diagnostic information, which, when collated over time, shows the progress made. It is recommended that each child have a baseline assessment with six-monthly follow-up evaluations. Having a protocol that guides assessment intervals aligns with international standards of care. Indicators that a child may need more support include:

- Insufficient calm-alert moments
- Disengagement in the presence of warm, loving relationships
- Lack of spontaneous orienting to face-to-face interactions
- Poor visual attention
- Disengagement in play and communication interaction
- Lacking in curiosity about the world
- Not acquiring nonverbal intentional communication behaviours
- Overemphasis by adults on establisihng joint attention in play
- Not developing nonverbal skills of turn taking, imitation and matching
- Not persisting in getting needs met or in overcoming appropriate challenges
- Poor sensory regulation: impulse control or emotional control
- Delays in innate vocal development
- Global developmental delays
- Plateaus or regression in progress

When children show slower than typical progress with listening, collaboration with the HHP who fit the hearing device is essential to ensure that the child has access to all sounds across the frequency range. Both threshold levels to tones and responses to speech are important. Data logging, or wear time, plays a significant role in how quickly or well children build auditory attention that supports understanding. Families who struggle to attend regular sessions, who are challenged by integrating new skills into their parenting styles or who do not have access to specialised intervention services may progress more slowly. This also holds true for children with additional needs beyond HL.

The impact of HL extends beyond the ability to speak clearly. Research proves that the presence of an HL can have an impact on higher-level cognitive skills, including theory of mind and executive function skills. Theory of mind refers to the ability to put oneself in the mind of another and is essential to develop empathy and maintain healthy relationships. Executive function refers to a set of brain-based processes responsible for the active management and control of cognitive resources, emotions and behaviours. Executive function allows for planning, organising and achieving goals (Barkley 2012). These skills also include aspects of working memory, time management, impulse control, emotional regulation and flexibility. When working with children with HL, it is essential to incorporate activities that develop theory of mind and executive function skills from an early stage.

Conclusion

HHPs may hope for sessions to unfold flawlessly, but true growth occurs through continuous learning and reflection. Each family provides new insights and opportunities to enhance clinical practice. By staying open to change, nurturing curiosity and maintaining high standards, professionals can ensure that children with HL receive the best possible support. When HHPs do what it takes, children thrive.

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